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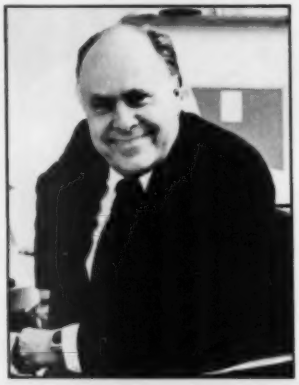

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

ATLANTA, DALLAS, ETC.

The last few months have been exceptionally busy and exciting for me. They have taken me to several countries and a number of hamfests and computer shows. More important, in the long run, are the political implications . . . and by that I mean with regards to the future of amateur radio . . . of these last few weeks.

A year ago, in a newsletter to the ham industry (dated May, 1977), I outlined the dangers of the coming WARC conference in Geneva. Being one of the few surviving delegates from the last WARC conference (1959), I perhaps have a little more perspective on the whole situation than people who have not been through one of those conflicts. That was twenty years ago and most of the people involved have either died or retired by now, so we have a new generation of innocents preparing for what promises to be a bloodbath.

Those few of you readers who have hung in there with me for the last twenty years or so have read all of this before. Hmmm . . . I wrote my first editorial in a ham publication just 26 years ago. Luckily I didn't suspect what I was getting into.

To go over history very briefly. In 1959, I arrived at Geneva to meet with the delegates from over 100 countries of the world. I found that though a few were amateurs, they were representing commercial or military interests, not amateur. The only country that permitted amateurs to be represented on their delegation was the U.S., with me and a chap from the ARRL being it. In reading over the official positions of the other countries, I found that few had any respect for amateur radio and that most were proposing drastic slashes in amateur frequencies.

In general, we were in a little better shape with the European countries, with the worst positions for us being proposed by Australia and India. Australia was demanding that all ham bands be cut to 50 kHz . . . and this was their official proposal. India wanted them cut to 20 kHz. Bless India.

Through an almost unbelievable stroke of good fortune, the U.S. managed to get reallocations in the 3-30 MHz bands put off until the next conference, scheduled for 1969. If a writer used a coincidence as weird as the one that happened, he would be laughed at. The U.S. was not trying to save the ham bands by this move; they were just trying to hold on to the disproportionate number of frequencies they had grabbed for many services at Atlantic City in 1947 and at previous ITU conferences.

The fact is that, even though the official U.S. WARC proposal called for continuing the ham bands as they were, I found that the members of the U.S. delegation had private orders to replace any losses to their service by taking frequencies from the nearest ham band. We had no friends at that conference, believe me . . . and the most predatory of all of the delegates turned out to be hams wanting to take ham frequencies for their employers. This is one of the reasons I laugh a little when I hear an ARRL president tell a gullible audience that we don't have to worry, hams on the foreign delegations will help us protect ham frequencies. Ha.

By 1965, the newly-chartered African countries were joining the ITU and swinging the balance of power. By 1966, I became concerned enough about the situation to look into it and see what I could do. I had been visiting the ITU pretty regularly, keeping in touch with the hams there and getting the inside information on what was really going on. I visited the ITU in 1958, 1959, 1961, 1963, 1965, and 1966. My visit in the spring of 1966 made it seem important to me to arrange for a trip to visit some of the countries involved and see some of the top ITU people.

That summer I went to Africa and visited the hams in Kenya, Uganda, Ethiopia, Sudan, and Egypt. While in Addis Ababa, I had the opportunity to get together with the just-replaced secretary-general of the ITU. I talked with him about the importance of amateur radio to emerging nations as an inexpensive source of technicians, and he thought this was an important concept which should be brought to the attention of the current secretary-general, an Indian. I DXed my way up to India, stopping off on the way to visit and operate in Lebanon, Syria, Iran, and Afghanistan. I visited Iraq, but was unable to get permission to operate there.

Mr. Sarwate, meeting me in Delhi, was most interested in what I had to say about amateur radio and its benefits to new nations. We discussed getting the ITU to back a plan for developing amateur radio in these countries, and I agreed to

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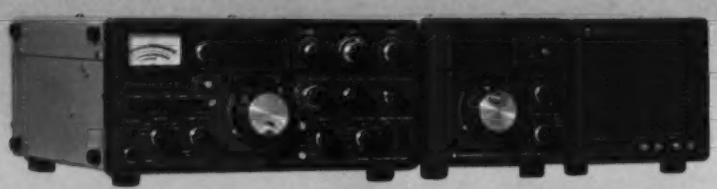

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write a set of rules for small countries which would encourage amateur radio to develop. Many countries were completely unaware of amateur radio and, even if they were interested, didn't know how to get it going.

Upon returning home, I set about preparing a set of regulations for the ITU to recommend. Before I could get them to Mr. Sarwate, he had the bad luck to drop dead and I found myself back on square one. I would have liked to take a trip to visit his replacement, but when I returned from my three-month trip, I found *73 Magazine* in terrible shape. We were over a month behind in publication and virtually bankrupt. It took me a couple of years to get *73* back into good enough shape so I could even think of leaving it for more than a few days.

My visit to the ITU in 1968 confirmed that the African nations had taken control. The European countries still had enough clout to prevent the scheduled 1969 WARC, but not enough to hold their frequencies if the conference had been permitted. By the '70s, the Europeans couldn't even prevent the 1979 conference, though they knew it would be a terrible experience.

The African countries have been voting in a bloc to rectify the frequency situation. Their view is that 10% of the world grabbed 90% of the frequencies in the past, and they, by damn, are now going to get their share and then some. They flexed their muscles in 1971 at the satellite conference when they wiped out all of the ham microwave satellite allocations. We went in with 239,249 MHz of ham satellite channels, enough so every ham in the world could have been in contact with any other via a set of three synchronous satellites within a few years. We lost every single Hz of those allocations. The report is in *QST*, where the ARRL admits that they went into the conference unprepared and lost everything. Oh, we did keep a little bit of the VHFs, but not enough to be of much use . . . and the real future of amateur radio, the microwaves, were cut off.

The white countries ran into this African buzz saw again in 1973 when the maritime interests got together for an interim ITU conference and the African bloc wiped them out, ignoring all technical advice and grabbing every channel they could—even the totally landlocked nations. What will they be doing with these frequencies? None of our business, they say, and if they want to rent them out or sell them, that's their prerogative.

JORDAN

During my visit to Jordan in 1970, I talked with King Hussein about the advantages to his country of amateur radio. I explained about the hobby as a way of getting almost free technicians, particularly as compared to the cost of bringing in Swiss or German technicians and engineers, which often run to $500 a day or more. He liked the idea and had me explain it to his government.

They started right in with this idea, even though Jordan was in the middle of a civil war between the Palestinians and the Jordanians. They set up ham stations in every youth club in the country and got the kids interested in amateur radio. His Majesty asked me to come back in 1973 and see what had come of my idea, and I met about 500 enthusiastic Jordanian hams, all in their teens, as I visited ham clubs from one end of the country to the other. They were just about to start work on the first Jordanian electronics factory . . . something which would have been impossible just three years before.

Just recently, I noted a piece in the *Herald Tribune* quoting a communications student at the University of Amman! From zero technicians to communications graduates in so few years . . . it shows what can be done.

ARMA

When ARMA (Amateur Radio Manufacturer's Association) was first formed in 1977, I brought up the problem of getting African votes for amateur radio at WARC, but the manufacturers were too busy worrying about bylaws, who was going to be president of the group, FCC hassles, etc. This was why I put the information on the subject in my May, 1977, newsletter to the industry. I hoped that something would come of it at their Atlanta '77 meeting . . . nothing did.

I brought it up again at the next ARMA meeting in Vegas during SAROC '78. Nothing happened again. Though I was elsewhere during the Dayton Hamvention, I did get a tape of the ARMA meeting and nothing more happened. With Atlanta being the last meeting of the year, I sent out one more newsletter in May, 1978, outlining the problem and my proposed solution.

ATLANTA

HR Report (I called it half-right reports, but then I am often accused of exaggeration) said . . . "Wayne Green will present a WARC '79 'progress report' to the ARMA meeting in Atlanta next week. Since he has yet to participate in any of the U.S. WARC preparation that's been going on in Washington since 1975, it should be an interesting presentation. Noel Eaton VE3CJ, who has attended WARC preparation meetings throughout the world for the IARU, will also be present and may contribute some appropriate observations."

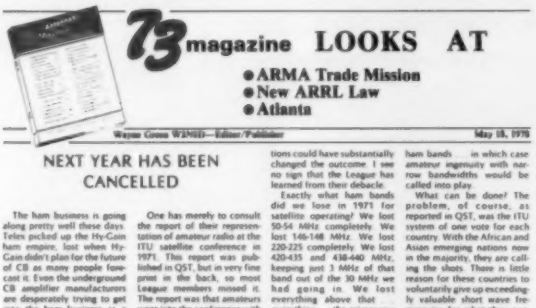
Hopefully, the sarcasm of the above is not lost on you.

Indeed, I did report to ARMA, though not on WARC directly . . . as *HR* very well knew. In view of the lack of support for the U.S. position at WARC, I didn't think it worth a lot of time to argue endlessly over it. What a waste of time. I presented my perspective on the possible outlook for WARC, and I played several minutes of a tape recording I had made four days earlier in Geneva when I interviewed one of the hams at the ITU. The tape is unofficial, so I can't quote it directly. Visitors to *73* or to some of my talks at hamfests will have a chance to hear it. The impact is strong: I was unable to find anyone at ITU who held out much hope for ham bands after 1979. The idea of a mission to Africa to interest countries in the value of amateur radio to them, with the example of Jordan to show, was deemed the only hope.

ARMA also listened to Eaton, and I also have a tape of that for those interested. He reported that the IARU, the international arm of ARRL, had approached many African countries for support at WARC. That sounded good. ARMA members pushed for more details, which were finally drawn from Eaton. It seems that the IARU has worked *only* in countries where they already have an IARU member society. Obviously these are countries where they already have an IARU member society. Obviously these are countries where amateur radio is relatively well developed and not a serious problem in the first place. Eaton was asked about contact with the so-called "black bloc" . . . no, none of them, only the IARU member countries, and those on a lower level, not on top, where it counts.

After hearing that, ARMA voted overwhelmingly (one nay) to support a mission to Africa and to fund it by asking amateurs and the industry to send in $10 to $20 a week each for a period of three months. With the full cooperation of the industry, this would more than provide the $20,000 a month a mission would cost.

Joe Brunzo of *Ham Radio* magazine volunteered to prepare a letter to be sent to the industry within the next few days to get the money started. I discussed this with him, pointing out that, in view of *Ham Radio* magazine's rigid support of ARRL policies, he might not be permitted to prepare the let-



73 magazine LOOKS AT

- ARMA Trade Mission
- New ARRL Law
- Atlanta

Wayne Green W2NSD—Editor/Publisher — May 18, 1978

NEXT YEAR HAS BEEN CANCELLED

The ham business is going along pretty well these days. Telex picked up the Hy-Gain ham empire. Just when Hy-Gain didn't plan for the future of CB as many people have cost it. Even the underground CB amplifier manufacturers are desperately trying to get into the ham business as a means of survival. Most ham manufacturers are having more problems with keeping up with orders than looking for more business. With very few exceptions things are going great and the worries are over immediate problems, not what is going to happen next year or what happened last year.

How much serious thought have you given to what you would do if amateur radio were totally cancelled next year! Whether such a possibility is a remote chance or a sure thing depends upon whom you consult. My own contacts are knowledgeable and wide in this field and I can say that I know of no one involved with the coming ITU conference next year who holds out much hope for our survival.

Many amateurs point out that certainly the ARRL is aware of this and must therefore be working hard to do something about it . . . to prepare. While this does seem both likely and reassuring, the League has had a clear history of not preparing for these ITU meetings in the past and there is no hint that they are doing anything this time.

One has merely to consult the report of their representation of amateur radio at the ITU satellite conference in 1971. This report was published in QST, but in very fine print in the back, so most League members missed it. The report was that amateurs went into the conference with satellite ham bands allocated in eleven UHF bands for a total of 237,249 MHz of frequencies. This was enough to allow amateurs to consider putting up a set of synchronous satellites which would permit every amateur in the world to talk with any other via satellite and relatively low power UHF ham gear.

And what was the result of this ITU allocation conference as reported in QST? Buried in the back pages in fine print was the report that they lost all but 5 MHz of those allocations. That's right, they went in with 237,249 MHz of ham satellite UHF frequencies and came out with 5 MHz. Obviously this cut off forever most of the future development of microwave radio . . . unless there is some question in your mind about the development of microwaves and satellites as being the future of communications.

The QST report lamented that the ARRL had not made the necessary preparations for the conference. Indeed, in light of the things that happened, it was obvious that even a modicum of preparations could have substantially changed the outcome. I see no sign that the League has learned from their debacle.

Exactly what ham bands did we lose in 1971 for satellite operating? We lost 50-54 MHz completely. We lost 146-148 MHz. We lost 220-225 completely. We lost 420-435 and 438-440 MHz, keeping just 3 MHz of that band out of the 30 MHz we had going in. We lost everything above that and everything . . . the microwave horizons of amateur radio were wiped out completely.

Every indication is that unless something is done and done immediately the ham short wave bands will go the same route as the UHF bands and for the same reasons. I explained this situation in a letter to advertisers dated May 1977 . . . and it fell on blind eyes. No one did anything about it at Dayton last year, or even at the Atlanta ARMA meeting. Now we've had another Dayton ARMA meeting with nothing more than some infighting and jostling, and nothing concrete accomplished. The very last chance to do something will be at Atlanta.

LAST CHANCE: ATLANTA

There are two major moves that the ham industry must make if it wants to take any positive action toward survival. The alternative is the ARRL route of just letting things happen and hoping for the best . . . as we did in 1971. Well, we lost 99.9964% of our satellite frequencies at that ITU meeting. If we suffer the same loss on the short waves we would come out of the meeting with 109.4 Hz of ham bands . . . in which case amateur ingenuity with narrow bandwidths would be called into play.

What can be done? The problem, of course, as reported in QST, was the ITU system of one vote for each country. With the African and Asian emerging nations now in the majority, they are calling the shots. There is little reason for these countries to voluntarily give up exceedingly valuable short wave frequencies for what they consider as an American hobby. This calls for a personal sacrifice on their part for something which is of no interest to them.

The real fact is that these amateur bands could be the single most valuable resource these countries could have in radio spectrum. Jordan proved that within three years a very small and poor country could develop enough radio amateurs to make it possible for them to get involved in the manufacture of radio equipment. In just three years Jordan went from having zero hams to having over 500 licensed amateurs, almost all teenagers, and most of them thus interested in technical careers.

With imported technicians and engineers costing up to $1,000 per day, and few available at much under $300 per day, emerging nations can't afford much in telephone or radio communications development. Thus both business and government work is hobbled by poor phone operation and slow international communications. A corps of interested hams in a country make it possible to get a lot

New, Remotable 2meter Mobile!

ICOM's New IC-280

ICOM introduces its new 2 meter mobile radio with the detachable microprocessor control head, the **IC-280**. Bright, easy to read LED's and a new style meter grace the brushed aluminum "new look" front panel of the detachable control head, which provides memory and frequency control for the remotely mountable main section.

The **IC-280** comes as one radio to be mounted in the normal manner: but, as an option, the entire front one third of the radio detaches and mounts by its optional bracket and the main body tucks neatly away out of sight. Now you can mount your 2 meter mobile radio in places that seemed really tight before.

With the microprocessor head the **IC-280** can store three frequencies of your choice, which are selected by a four position front panel switch. These frequencies are retained in the **IC-280's** memory for as long as power is applied to the radio. Even when power is turned off at the front panel switch, the **IC-280** retains its programmed memories; and when power is completely removed from the radio, the ±600 KHz splits are still maintained!

Frequency coverage of the **IC-280** is in excess of the 2 meter band; and the new band plan (144.5-145.5 MHz repeaters) can easily be accommodated, since it was included in the **IC-280's** initial planning by the ICOM design team.

The main section of the **IC-280** puts you up to the minute with the latest state of the art engineering. The new **IC-280** includes the latest innovations in large signal handling FET front ends for excellent intermodulation character and good sensitivity at the same time. The IF filters are crystal monolithics in the first IF and ceramic in the second, providing narrow band capacity for today and tomorrow's crowded operating conditions. Modular PA construction with broad band tuning provides full rated power across the full 2 meter band (plus a little).

All ICOM radios significantly exceed FCC specifications limiting spurious emissions.

Specifications subject to change without notice.

IC-280 Specifications: ☐Frequency Coverage: 143.90—148.11 MHz ☐Operating Conditions: Temperature: −10°C to 60°C (14°F to 140°F), Duty Factor: continuous ☐Frequency Stability: ±1.5 KHz ☐Modulation Type: FM (F3) ☐Antenna Impedance: 50 ohms unbalanced ☐Power Requirement: DC 13.8V ±15% (negative ground) ☐Current Drain: Transmitting: 2.5A Hi (10W), 1.2A Lo (1W); Receiving: 0.630A at max audio output, 0.450 at SQL ON with no signal ☐Size: 58mm(h) x 156mm(w) x 228mm(d) ☐Weight: approx. 2.2 Kg ☐Power Output: 10W Hi, 1W Lo ☐Modulation System: Phase ☐Max. Frequency Deviation: ±5 KHz ☐Spurious Output: more than 60 dB below carrier ☐Microphone Impedance: 600 ohms dynamic or electret condenser type, such as the SM-2 ☐Receiving System: Double superheterdyne ☐Intermediate Frequency: 1st: 10.695 MHz, 2nd: 455 KHz ☐Sensitivity: 1 uv at S +N/N at 30 dB or better, Noise suppression sensitivity 20 dB, 0.6 uv or less ☐Selectivity: less than ±7.5 KHz at −6 dB, less than ±15 KHz at −60 dB ☐Audio Output: More than 1.5W ☐Audio Output Impedance: 8 ohms

HF/VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

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Here's Helen Harris W1HOY/KP4 on the left, me, and Sam Harris W1FZJ/KP4 on the right. Sam had a serious bout with lung trouble last year, but is back in fighting trim now. He's stopped smoking. For newcomers to amateur radio, Sam was the chap who invented the first parametric amplifier—he built it to work on 6m—and he was the promoter of a series of moonbounce developments, including the use of the 1000-foot dish at Arecibo for 1296 MHz ham moonbounce a few years back. Sam runs the lab at Arecibo, the world's largest radio telescope.

I first visited Sam when he was W8UKS out in Burton, Ohio, when we were both involved with 75m DXing. Later he moved up near Boston and became the VHF editor of CQ while I was editor of that magazine. When CQ got over a year behind in paying him, he switched over to QST, where he battled their anti-Technician policies for some years, finally quitting them.

Sam today is one of the foremost microwave scientists in the world, though a scientist in the historic sense in that he designs and builds things himself, not just with a computer doing the calculations and some technician the dirty work.

ter. He laughed.

THE ITU

My travels started back in late April with a trip to Los Angeles for a microcomputer show. This was the same weekend as Dayton, so other *73 Magazine* staffers covered for me at Dayton. While in L.A., I got together with several ARMA members and discussed the WARC situation, and was able to make arrangements for the Japanese Ham Manufacturer's Association to fund and supply a very well qualified man for the proposed African mission, thus making it an international affair.

From there, I flew back to New York for a day at the Premium Show, then on down to Arecibo for a visit with Sam Harris W1FZJ/KP4 and his wife Helen W1HOY/KP4. The big dish there has been substantially improved since my last visit (1968), and there is growing interest in using it for a ham moonbounce weekend again. I was surprised and pleased to find that much of the dish's time is spent in looking for LGMs. They have a very big computer which analyzes everything coming in for anything which has a pattern, affectionately called looking for Little Green Men.

Eastern Airlines has one of the darnedest fares yet . . . for about $20 less than round trip to California, Sherry and I were able to fly to California, Atlanta, New York, Puerto Rico, Saint Martin, and back to Boston. We spent a couple days skin diving on Saint Martin (FS7/PJ7), then flew back to New Hampshire for a couple days . . . next to Birmingham for their hamfest . . . home again for a couple more days, then off to London to visit microcomputer stores and manufacturers . . . Paris for Micro-Expo, where I spoke to a packed house on microcomputer software . . . then up to Switzerland for the visit with the ITU.

I felt that the visit to the ITU headquarters was very important as a way of reinforcing my own observations on what has happened, what is happening, and what appears as if it will happen. The projection that looks likely to me is so terrible that I just couldn't really believe it. I felt the same as the high ARRL staffer I talked to recently who answered when I asked him about the possibility of our losing all ham bands next year, "They *can't* cancel amateur radio!" It is just unthinkable.

Unfortunately, I am able to at least consider the possibility of the totally unthinkable, so I guess I was searching for reassurance and I felt that if anyone in the world might have a finger on the pulse of the WARC, it would be the people who are in the middle of it in Geneva. I decided to extend my Paris trip to Geneva and try for some encouraging words at the ITU. As I said earlier, I was unable to find anything to be optimistic about at Geneva. I talked with a number of people there, most of whom I have known for many years and have found most dependable and strongly on the conservative side.

Since I seem unable to really do anything about the situation, I will resume my complacent pose and join the ARRL and the rest of you with crossed fingers as a shield against the future, hoping that all will indeed be well and that I have been a worrywart for nothing. The ARRL may just be right— perhaps the ITU *can't* cancel amateur radio.

What are the chances of the U.S. ignoring the WARC decisions? I asked at the ITU about this. They say that this is impossible. What about the U.S. getting a footnote into the allocations table so U.S. amateurs can carry on? That's possible, but there wouldn't be much DX. This *could* keep 2m going, if such a move could be gotten through the ITU meeting. I'll be investigating these options.

THE MONEY NEEDED

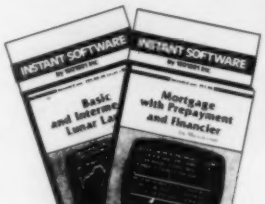
The amount of money needed for the proposed mission is so insignificant when compared to ham sales that the resistance of manufacturers to funding is difficult to understand. I calculate it would run about $20,000 a month. I based this on a rough estimate of $100 per day per person, which is about what things cost in Europe these days. I also figured that since the people on the trip would be business people, they would have to get back to the U.S. every now and then to keep their businesses going. Figuring four people for three weeks, plus a round trip fare once a month, plus a couple gift ham stations for each of the three countries visited during each monthly trip, I came up with around $20,000.

On the one hand, that's a lot of money, but compared to the U.S. ham sales of over $100,000,000 per year, it's peanuts. With 231 different advertisers in the most recent issues of *73* and *QST*, I figured that if each of these put up just $20 a week for one month, we would have our $20,000. Check that out on your hand calculator. We have about 500 ham distributors plus over 1000 manufacturers, and who knows how many hams who could afford to send in money. No, the twenty thou should be easy to get, if anyone asked for it.

WHAT HAPPENED

When I got back from my latest round of ham and computer shows, I called Jack Burchfield of Ten-Tec to see what had come of the letter from *Ham Radio* asking for the industry to send money to ARMA for the mission and to the request for same in *HR Reports*. Jack said that the *HR* mention was minimal and no letter had been written and that, as far as he was concerned, that was the end of it. I agreed.

I explained to Jack that the *Kilobaud* exhibit at NCC in Anaheim had shown our new line of mass-produced software for the Radio Shack TRS-80 and the Commodore PET microcomputers. The orders already received and promised showed that we had a bull by the tail and I was needed at home to organize our growth to meet this new market. I said that while I would do everything I could to help amateur radio, I was not going to be foolish enough to be the only one to make the effort. Now that the industry knew the score, the ball was in ARMA's court.



INSTANT SOFTWARE

The concept behind our publishing software just as we do books and magazines was to make a large number of programs available for microcomputers. Without these programs, I could see a gradually growing public resistance to buying computers and another disaster something like the CB debacle coming. Computers are of no earthly use if you don't have programs for them.

Since it takes a lot of experience and time to write significant programs, I figured that the people who were doing this should get proper rewards in the form of royalties when their programs were sold. So far there has been little effort to do this, with the result that there are virtually no programs available for microcomputers.

The first thing I did was set

Continued on page 148

The evolution of the MLA

When the MLA-2500 was first introduced it was a new concept in high performance amplifiers. Low and sleek yet powerful enough for the military. Some wondered . . . needlessly.

A promise kept.

The MLA-2500 promised 2000 watts PEP input on SSB. A heavy duty power supply. Two Eimac 8875's. And as thousands of Amateurs across the world have proven, the MLA-2500 delivers!

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What better test for an amplifier than the Clipperton DXpedition? Even after 32,000 QSO's, and an accidental dunk in the ocean, the same 3 MLA-2500's are still amplifying other rare DXpeditions around the world – listen for them.

Convinced? Isn't it time you owned the amplifier that powered Clipperton and thousands upon thousands of radio stations throughout the world?

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LETTERS

THE CRRL AND 2M

I would like to enclose a copy of a letter from the CRRL concerning a proposal which, if passed, would eliminate all amateur activity on the two meter and 1¼ meter bands. One has to wonder about the intelligence of some of our overpaid and underemployed civil servants. As the Experimenter's license was to demand a high degree of technical knowledge, I wonder if there would be more than 100 people in all of Canada who would be interested. If the qualifications were to be lowered so as to include the CB types, not much interest would be shown in pulse or packet emissions. As this proposal would, if accepted, seriously affect two meter and 1½ meter activity adjacent to the border, perhaps you will find this of interest.

I enjoy your magazine, although I believe the ARRL receives more than its share of criticism. I like the Ham Help letters, as it appears that amateur radio is becoming sort of impersonal and many contacts are only for the purpose of collecting QSL cards.

I don't consider it a QSO to exchange name, address, and signal reports. We seem to be losing the ability to communicate with each other. We need a lot more rag chewers on the bands. Amateurs have too many repeaters on the air, sitting idle most of the time. Many are built out of spite or disagreement with other groups. You find that after an initial contact through a repeater, it is in many cases impossible to find anyone to talk to, as all the listeners feel they know who you are and where you are from. Is not one of the reasons for being a ham a sense of belonging to a group of people with similar interests? Perhaps we need to cultivate our abilities to talk to each other. We have lots to discuss, even the bureaucrats' attempts to get rid of us entirely.

As the present restrictions being placed on amateurs are due to the problem created by the illegal operation of CBers, a better solution could be a resumption of fees and a use of the money thus collected to apprehend and impose severe penalties on these people. At the present time, there appear to be only feeble attempts to apprehend the illegal CBers or HFers, and if they are caught, they receive nothing more than a slap on the wrist. The ban on 10 meter linears I don't believe is any hardship on anyone. In fact, amateur radio would probably be better off if linears of all types were banned.

Willis Wood VE5WV
Estevan, Saskatchewan
Canada

I am grateful to Jack Reed VE3GMT for presenting this opportunity of briefly addressing you concerning a recent DOC proposal of far-reaching importance to the welfare of the Canadian Amateur Experimental Service, both nationally and internationally.

On March 1st, DOC issued its formal Canada Gazette proposals for their new code-free Experimenter's License. These proposals contained many surprises to your national organizations, many of which were at variance with discussion results at the recent DOC Amateur Symposium. Experimenter frequencies are proposed from 144 MHz up (no HF privileges), but of extremely serious consequence is the proposal to permit *only* Experimenters pulse modulation emissions on our two meter band, and, in addition, the deletion of *all* present emission forms between 220 and 225 MHz, except that of "packet radio." Packet radio is a technique through which packets of data may be broadcast over a communication channel which is shared by a number of users.

Although not conclusive at this point in time, the League considers that permitting pulse modulation over practically the entire two meter band could seriously interfere with and otherwise jeopardize present extensive repeater operations. Additionally, the present two meter OSCAR frequencies on this band could be seriously affected. Of equal if not perhaps greater concern is the Department's proposal to limit 220-225 MHz emission to that of "packet radio" only, thereby effectively precluding our projected repeater growth into this presently authorized band, not to mention the resultant interference which will occur to present and future U.S. repeaters adjacent to the border.

Dr. deMercado (Director General of the DOC Regulatory Service), the apparent architect of these proposals, strongly feels that the implementation of these new regulations will launch Canadian amateurs into orbit as the world leaders in the development of these new communications techniques. We regret that we are unable to share his enthusiasm, especially with respect to the specified frequencies. The League does not wish to contradict the concept envisaged by Dr. deMercado, but *we are categorically opposed* to the particular spectrum frequency space which has been stipulated.

We suggest that there are other higher frequencies available, just as technically suitable, which would not severely handicap our present well-justified operations in the 144-148 and 220-225 MHz bands.

Technical progress and investigations are, of course, important justification factors for our service, but not, we respectfully suggest, if it should negate or otherwise sacrifice the other important facets of the amateur service by which amateurs have become acknowledged and proven national resources to our nation in both peace and war!

The CRRL shall shortly be making a complete and technically qualified presentation to the Department in respect to these proposals; however, we strongly wish to urge all individual amateurs to make their comment known direct to the DOC (Department of Communications, 300 Slater Street, Ottawa, K1A 0C8).

Thank you for your cooperation in helping us to help you.

Ron J. Hesler VE1SH
Director, CRRL

PRIORITY OVERRIDE

Your plan for converted CB sets on ten meters is the most logical I've seen to date, but it has one very important flaw.

As the Coast Guard found out decades ago, an emergency channel has to be used for calling and working channels for traffic after contact is established, so that people will always be listening.

Your idea to use the channel one position of converted sets for calling and listening is good, except for one thing: Many of the CB sets include a "Priority Override" switch which allows channel nine to interrupt reception on any other channel, as long as the switch is on. This feature, if used by hams, would allow QSOs on other channels to be interrupted by a call on channel nine, thus allowing the owner to monitor both a local channel and the calling channel.

I suggest, therefore, that you should change the calling and listening channel to channel nine, at 29.065 MHz.

Ernest W. Horne WD6FZY
Isla Vista CA

A BETTER FEEDTHROUGH

I read with extreme interest the article, "A Better Feedthrough for Cables," page 50, June, 1978, issue of *73*.

It was my choice for June's article winner, and an excellent one it is.

I submitted that same design to the ARRL and they published it in the July, 1976, issue of *QST*, page 41. I feel you gave the design a better layout than *QST* did mine. Anyway, keep up the fine magazine—I really enjoy reading it and have been a subscriber since last year.

By the way, this method has been used at my QTH for over two and a half years.

Keith H. Gilbertson WB0LXM
Detroit Lakes MN

A WORD FROM THE NBS

While we are delighted with Mr. Bloom's enthusiasm for the frequency calibration service using the TV network color subcarrier, there are some misleading and/or inaccurate statements in his article that should be clarified (see "In Search of the Ultimate—an incredible counter calibrator," April, 1978, issue, p. 66).

NBS operates two HF radio stations, WWV in Ft. Collins, Colorado, and WWVH on Kauai, Hawaii. At the present time, both stations transmit on 2.5, 5, 10, and 15 MHz. The accuracy of the WWV/WWVH frequencies as *transmitted* is better than 1×10^{-11} (not 1×10^{-9} as stated by Bloom). The frequencies are generated by cesium beam atomic frequency standards located at the stations which are steered in long-term to agree with the NBS Frequency Standard in Boulder, Colorado. *Received* accuracy, correctly stated by Bloom, may be degraded to 1×10^{-7} by propagation path disturbances.

Mr. Bloom also referred to NBS station WWVL. These VLF transmissions, formerly operated at 20 kHz on an experimental basis, were terminated on July 1, 1972.

It is *not* true that NBS LF station WWVB on 60 kHz radiates

only frequency information. The format contains a BCD time code at a one-pulse-per-second rate, providing day of year, hours, minutes, seconds, and the difference between Coordinated Universal Time (UTC) and astronomical time, UT1.

NBS did not consult with the four TV networks, nor did NBS suggest that the networks stabilize their color subcarriers (control the frequency of the color burst). The networks began using atomic rubidium standards in 1968-1969 to solve an operational problem relating to synchronization of "remote" color broadcasts, such as sporting events. The stability of rubidium standards allowed these remote pickups to be "locked" to the network centers using one of several techniques described in the SMPTE (Society of Motion Picture and Television Engineers) journals in 1969-1970.

When we at NBS learned that the networks *were* installing atomic standards, we began looking into methods of utilizing the network subcarriers as frequency transfer standards, and many people are now using this technique for oscillator calibration. It is a quick, relatively inexpensive calibration method, and with care, one can achieve accuracies better than 1×10^{-10} with a high confidence level.

This would also seem to be an appropriate time to mention a new development in the use of the color subcarrier technique. The networks began using rubidium standards to solve some of their synchronization problems. However, the digital frame synchronizer now allows them to solve the same problems in a more flexible manner. Unfortunately, when a local station places a frame synchronizer "in series" with the network line, the highly stable atomic subcarrier reference is lost. Several of the network-owned stations are now using frame synchronizers so the viewers in their service areas can no longer receive the network subcarrier.

We at NBS are currently planning to survey all TV stations to determine how many stations are now using or plan to use frame synchronizers. We still feel that the color subcarrier is useful for frequency calibrations, but persons using this method should make measurements on more than one network so that the use of frame synchronizers by the local stations can be detected.

Dick D. Davis
Time and Frequency Division
National Bureau of Standards
Boulder CO

MINERAL OIL

This is in regard to the article, "Home Canned Dummy," page 154, *73 Magazine*, May, 1978. The author suggests filling the dummy load can with motor oil. This can be an unsafe practice. A little arcing, and presto, instant fire! A much better choice is mineral oil, available from any drugstore or pharmaceutical house at very reasonable cost, and very nearly impossible to ignite. Also, transformer oil, once a favorite for this application, has been found to cause cancer, though it has good dielectric properties and a high ignition point. My choice is light mineral oil.

Ed English W6WYQ
San Luis Obispo CA

BUILDING JAMMERS

I just subscribed to *73 Magazine* for 3 years and now I am beginning to wonder if I didn't make a mistake. You see, I made a special trip to the local ham store to purchase the May, 1978, issue in order to fill out the '78 series, and what should I find but an article telling hams to build police radar jammers.

Now seriously, Wayne, do you think a reputable ham magazine should be publishing this kind of information? Don't you think hams could spend their time to better advantage than building jammers? What about the legal aspects? Last time I looked at the regs, it was against the law to willfully cause interference to another service! If we want deregulation and a proud, self-governing hobby, then this is not the way to get it.

I hope the quality of articles improves or you will have to send the $36.00 back. I also subscribe to *Kilobaud* and hope I never see an article like that in it, either!

George H. "Bud" Saum KØGS
Westminster CO

HUMAN RELATIONS

In the June, 1978, issue, in an article by K5LUW entitled "Disguised Birdhouse Antenna," the author makes a very poor statement, i.e., "Also, if the sight of large antenna arrays automatically makes your neighbors' television sets start acting up and you are tired of those annoying phone calls every time you start operating, maybe what you need is a disguised antenna . . ."

Maybe you need an FCC citation or at least a course in human relations somewhere. It seems that the ARRL has you here—for many years, they have talked about the "proper" ways to handle TVI problems (and I cannot recall one solution being to "disguise" your antenna).

Yes, the author was talking about "cliff-dwelling" in an apartment where antennas were verboten (the "birdhouse" title is apt), but the statement does stand alone in the article as a means to avoid TVI complaints.

Granted, manufacturers do not design TVs, stereos, etc., with sufficient discrimination to reject a strong (but legal) ham signal. Nevertheless, I've always thought the ham should make himself known in the community and through goodwill (and maybe some extra effort like installing filters) solve the problem!

If the reason you're "disguising" your antenna is to circumvent a prohibition in your rental contract against outside antennas, I can understand it (but you are still acting illegally). If, in addition, it is to avoid TVI complaints, I contend it is not in the best interests of ham radio, even if your signal is entirely clean.

G. S. Wren K5EAT
Helotes TX

ANOTHER BELIEVER

Put me down as a believer, too! After two months with your code tapes, I passed the General test on 6/27. I started with a 5 wpm base and spent an average of one hour per day in practice. Who needs a receiver!

D. T. Capasso WB2NBI
Haddonfield NJ

RADIO LAW ENFORCEMENT

Perhaps we should have some further discussion in your magazine about what Dan Gingras said in his letter on radio enforcement (June, 1978, p. 61). I personally feel that some system of dealing promptly and without having to involve three agencies should be set up, and further, I understand revision of the Communications Act of 1934 is under consideration, so the time is now.

I am not a lawyer, but I have some training in criminal law. Traditionally, police officers have been permitted to arrest without warrant for breach of the peace. There are two ways this might be useful. First, Congress might rule that FCC inspectors and engineers were officers for this purpose. Certainly many of the offenses involved would be breaches of the peace if committed in a public place, and the radio waves, with as many people on them as we have presently, should be considered a public place. The other method, which will not endear me to the FCC, who would like to maintain complete jurisdiction, is to declare the radio waves to be a public place for the purposes of breach of the peace laws, thereby opening jurisdiction on non-technical violations such as swearing, interfering with emergencies, and other mischief to local law enforcement authorities.

For example, New Hampshire law provides for legal action against a person who "makes unreasonable noises in a private place, which can be heard in a public place. . ." Were the radio waves declared a public place, much could be done under this provision and other parts of the disorderly conduct law.

One idea that might be useful in such cases where FCC personnel were authorized to act on their own would be for them to go back to using inspectors. Field personnel at the moment are mostly field engineers, graduate engineers that cost more than a police lieutenant. They used to have a force of people with either a lot of experience or a tech school education, and could get more personnel for the money that way, for handling routine matters. Perhaps a system of part-time inspectors, as many towns use the "special police officer" to control fairs or other situations where personnel are needed temporarily, could be applied to radio. The knowledge that someone within 30 miles could be complained to, and had the authority to act, would cool off some of the regular offenders around here.

Perhaps you could have an attorney write an article on the subject and/or put some editorial weight behind this.

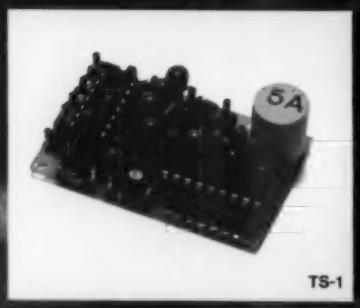
Joel S. Look W1KCR
Claremont NH

PIONEER LOST

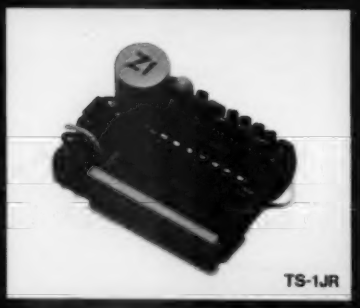
The unfortunate and untimely death of Mr. R. R. Freeland, Sr., President of International Crystal Manufacturing Company, Incorporated, has left a great void in the electronic industry.

Mr. Freeland and his wife Virginia were killed instantly when their twin engine Turbo-Commander exploded in midair just west of Oklahoma City on Saturday morning, May 27. He

Continued on page 96



TS-1



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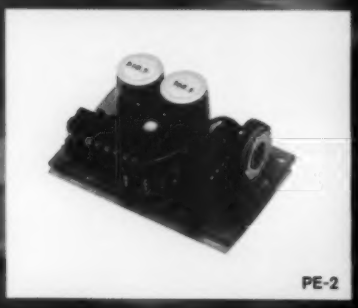
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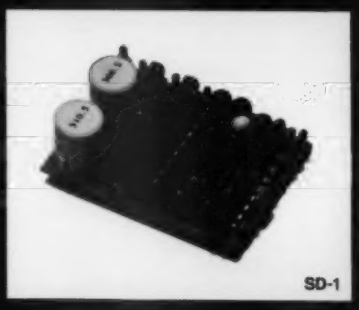
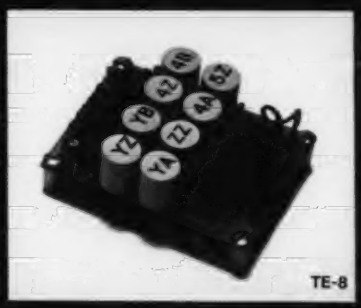

SD-1

THE DAWNING

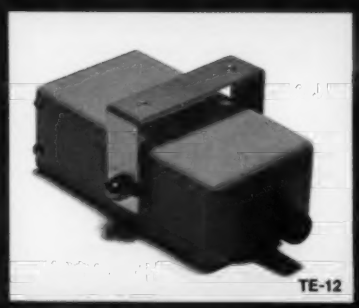
The age of tone control has come to Amateur Radio. What better way to utilize our ever diminishing resource of frequency spectrum? Sub-audible tone control allows several repeaters to share the same channel with minimal geographic separation. It allows protection from intermod and interference for repeaters, remote base stations, and autopatches. It even allows silent monitoring of our crowded simplex channels.

We make the most reliable and complete line of tone products available. All are totally immune to RF, use plug-in, field replaceable, frequency determining elements for low cost and the most accurate and stable frequency control possible. Our impeccable 1 day delivery is unmatched in the industry and you are protected by a full 1 year warranty when our products are returned to the factory for repair. Isn't it time for you to get into the New Age of tone control?

ME-3



TE-8


TE-12

ST-1

OF A NEW AGE.

TS-1 Sub-Audible Encoder-Decoder • Microminiature in size 1.25 x 2.0 x .65 • Encodes and decodes simultaneously • **$59.95** complete with K-1 element

TS-1JR Sub-Audible Encoder-Decoder • Microminiature version of the TS-1 measuring just 1.0 x 1.25 x .65" for hand-held units • **$79.95** complete with K-1 element

ME-3 Sub-Audible Encoder • Microminiature in size, measures .45 x 1.1 x .6" • Instant start-up • **$29.95** complete with K-1 element

TE-8 Eight-Tone Sub-Audible Encoder • Measures 2.6 x 2.0 x .7" • Frequency selection made by either a pull to ground or to supply • **$69.95** with 8 K-1 elements

PE-2 Two-Tone Sequential Encoder for paging • Two call unit • Measures 1.25 x 2.0 x .65" • **$49.95** with 2 K-2 elements

SD-1 Two-Tone Sequential Decoder • Frequency range is 268.5 - 2109.4 Hz • Measures 1.2" x 1.67" x .65" • Momentary output for horn relay, latched output for call light and receiver muting built-in • **$59.95** with 2 x 2 elements

TE-12 Twelve-Tone Sub-Audible or Burst Tone Encoder • Frequency range is 67.0 - 263.0 Hz sub-audible or 1650 - 4200 Hz burst-tone • Measures 4.25" x 2.5" x 1.5" • **$79.95** with 12 K-1 elements

ST-1 Burst-Tone Encoder • Measures .95" x .5" x .5" plus K-1 measurements • Frequency range is 1650 - 4200 Hz • **$29.95** with K-1 element

COMMUNICATIONS SPECIALISTS
426 W. Taft Ave. Orange, CA 92667
(714) 998-3021

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

For rules on the ARRL September VHF QSO Party, check the August issue of *QST*. The official rules were not available at the time this went to press and there will probably be a change or two from last year's rules!

PENNSYLVANIA QSO PARTY
Starts: 1700 GMT Saturday, September 9
Ends: 2359 GMT Sunday, September 10

Sponsored by the Nittany ARC; all amateurs are invited to participate. A "super activity" period has been arranged for Saturday evening, 2400 GMT and 1700 GMT, when it is hoped that many "casuals" will join the fun. PA stations may work both PA and non-PA stations. Each station may be worked once per band and mode (CW and SSB).

EXCHANGE:

QSO number, RS(T), county or ARRL section.

FREQUENCIES:

CW—1810, 3550, 7050, 14050, 21050, 28050; SSB—1815, 3980, 7280, 14315, 21380, 28560; Novice—3715, 7160, 21115, 28115.

SCORING:

PA stations score 3 points per out-of-state QSO and 1 point per PA QSO. Multiplier is number of ARRL sections, including EPA and WPA. One additional multiplier may be counted for DX QSO (limit: one). Out-of-state stations score 1 point per PA QSO times the number of PA counties worked (67 max.).

ENTRIES AND AWARDS:

Logs must include dates/times in GMT, stations worked, RST sent/rcvd., band, mode, and number of new section or county as worked (multipliers). Summary sheet required, showing number of QSOs, QSO points, total multiplier, and claimed score. Also, all entries should include a checklist of counties worked. Mail logs, summary sheets, checksheets, and any comments by Oct. 14th to: Douglas R. Maddox W3HDH, 1187 S. Garner Street, State College PA 16801. SASE appreciated. Certificates to section winners and outstanding PA entries, with minimum of 10 QSOs required for awards.

NORTH AMERICAN SPRINT CONTEST
Contest period runs from 0100 GMT to 0500 GMT September 10

Sponsored by the *National Contest Journal*; any licensed radio amateur may enter. The object is to work as many North American stations (and/or other stations if you are in North America) as possible and as many multipliers as possible during the contest period. All contest contacts must be made on CW on the 80, 40, or 20 meter bands only. Each station may be worked once per band. North American stations are as defined by the rules of the *CQ* WW DX contests.

EXCHANGE:

You must make the entire exchange as given below: his call, your call, serial number, your name, and your state or VE province or country. Serial numbers must begin with serial number one (001) and must be sequential thereafter.

FREQUENCIES:

3530-3550, 7030-7050, 14030-14050.

SCORING:

North American stations: Multiply total valid contacts by the sum of states, VE provinces, and other worldwide countries (do not count USA and VE as countries) to get the final score. Non-North American stations: Multiply total valid contacts by the sum of states, VE provinces, and other North American countries (do not count USA and VE as countries). KH6 is not counted as a state and is not a North American country. VE multipliers are: maritime (VE1, VO1, and VO2) and VE2 through VE8 (8 total).

SPECIAL QSY RULE:

This rule applies to North American stations only! If any North American station solicits a call by sending "CQ, QRZ?, QRZ?," etc., he is permitted to work only one station in response to that solicitation. He must thereafter move at least 1 kHz before he works another station, or at least 5 kHz before he again solicits other calls.

ENTRIES:

Entry classification is single operator only, with the use of helpers or spotting nets not permitted. Regardless of the number of licensed callsigns issued to a given operator, one and *only* one callsign shall be utilized during the contest by that operator. Proper logging requires including the time of each contact along with the contact exchange and the band or frequency. Only completely copied and logged two-way exchanges between a North American station and another station are valid for this con-

CALENDAR

Sept 2-4*	**Four Land QSO Party**
Sept 9-10	**Pennsylvania QSO Party**
	ARRL VHF QSO Party
Sept 10	**North American CW Sprint**
Sept 16-18	**Washington State QSO Party**
	Maryland/DC QSO Party
	Scandinavian Activity Contest—CW
Sept 23-24	**Scandinavian Activity Contest—Phone**
	Delta QSO Party
Sept 30-Oct 1	**Rocky Mountain Division QSO Party**
Oct 7-8	**QRP QSO Party**
	California QSO Party
	VK/ZL/Oceania DX Contest—Phone & RTTY
Oct 14-15	**VK/ZL/Oceania DX Contest—CW**
	Nine Land QSO Party
	RSGB 21/28 MHz—Phone
	Manitoba QSO Party
	ARRL CD Party—CW
Oct 21-22	**Jamboree-on-the-Air**
	RSGB 7 MHz SSB
	ARRL CD Party—Phone
Oct 28-29	**CQ Worldwide DX—Phone**
	CQ-WE Contest
Nov 4-5	**ARRL Sweepstakes—CW**
	RSGB 7 MHz CW
Nov 11	**OK DX Contest**
Nov 11-12	**IPA Contest**
Nov 18-19	**ARRL Sweepstakes—Phone**
Nov 25-26	**CW Worldwide DX—CW**
Dec 2-3	**ARRL 160 Meter Contest**
	TOPS CW Contest
Dec 9-10	**ARRL 10 Meter Contest**

***described in last issue**

RESULTS

RESULTS OF THE 1978 BARTG RTTY CONTEST

Top 10 Single Operator Stations

W3FV	**447,678 points**	**261 QSOs**	**39 countries**
SM6GVA	**440,578**	**297**	**26**
I3FUE	**432,066**	**315**	**36**
W2NZ	**403,374**	**249**	**37**
F9XY	**401,980**	**282**	**31**
I5WT	**380,482**	**261**	**35**
W1GKJ	**365,904**	**252**	**28**
I5KPK	**345,000**	**244**	**32**
I5MYL	**338,142**	**240**	**28**
HB9AVK	**325,686**	**197**	**33**

Top Multi-Operator Entry

DLØTS	**329,910**	**212**	**34**

Top SWL Entry

H. Ballenberger (DL)	**417,452**	**246**	**35**

Several US entries were received too late for inclusion in the official results, due to serious delays in overseas surface mail.

test. Entries must be sent to Rusty Epps N6SF, 35 Belcher Street, San Francisco CA 94114. Entries must be received not later than 30 days after the Sprint to be eligible for trophies and awards. An entry consists of (1) a summary sheet showing valid contacts by band, total multipliers, total score, name and callsign of the operator, station callsign, and station location; (2) a complete, legible log of all contacts (including dupes marked as such) with indication by numbered sequence of each multiplier claimed; and (3) a separate checksheet for each band. Logs, summary sheets, and checksheets may be homemade or patterned after those shown in the June/July issue of the *National Contest Journal*. Any entry may be disqualified for illegibility, incorrectness, or illegal or non-ethical operation. Such disqualification is at the discretion of the NCJ Contest/ Review Committee.

AWARDS:

A trophy shall be awarded to the highest scoring entrant. Certificates of merit shall be awarded to the highest scoring entrant from each USA call district, Canada, and other country, to each of the ten highest scoring entrants, to each member of the winning team, and to the highest scoring entrant on each team.

TEAM COMPETITION:

Team competition is limited to a maximum of 10 operators as a single entry unit. Clubs having more than 10 members may submit more than one team entry. *Precontest requirement:* To qualify as a team entry, the name, callsign of each operator, and callsign of the station operated should the operator be a guest at a station other than his own must be registered with N6SF. The team information may be contained either in a letter, which must be received by N6SF before the start of the Sprint, or in a Western Union Mailgram dated at least 24 hours before the start of the Sprint. There are neither distance limitations nor meeting requirements for a team entry. The only requirement is a pre-registration of the team.

DELMONT WAS CONTEST

Starts: 0000Z GMT September 16
Ends: 2400Z GMT September 17

The Delmont Radio Club of Hatboro PA will be conducting a Worked All States contest for a 48-hour period from 8 pm EDT, Friday, September 15, to 8 pm EDT, Sunday, September 17. Each club member will try to work as many states as possible, with awards based on 1 point per QSO and 1 point per QSL of same.

WASHINGTON STATE QSO PARTY

Operating Periods:
0100 to 0700 GMT September 16;
1300 GMT September 16 to 0700 GMT September 17;
1300 GMT September 17 to 0100 GMT September 18

Sponsored by the Boeing Employees' ARC (BEARS), the contest is open to all amateurs. All bands and modes may be used. Stations may be worked once per band and mode, and may be worked again if they are a new multiplier.

EXCHANGE:

WA stations send QSO number, RST, and county; others send QSO number, RST, and state, province, or country.

FREQUENCIES:

CW—1805, 3560, 7060, 14060, 21060, 28160; phone—1815, 3925, 7260, 14305, 21380, 28580; Novice—3725, 7125, 21150, 28160.

SCORING:

Score 2 points per QSO. WA stations multiply QSO points by total number of states, provinces, and other countries worked. All others score 2 points per WA QSO and multiply by number of WA counties worked (39 max.). For non-WA stations only, there is an extra multiplier of one for each group of 8 contacts with the same WA county.

Washington county checkoff list for non-Washington State entries: Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Wahkiakum, Walla Walla, Whatcom, Whitman, Yakima.

ENTRIES AND AWARDS:

Certificates to high scores in both single and multi-operator classes. Five BEARS awards are also available to anyone working 5 club members. All contest entries will be screened by the contest committee for possible Worked Five BEARS Awards. The Worked 3 BEAR Cubs Award is also available for working 3 Novice members. Logs must show dates/ times in GMT, stations worked, exchanges, bands and modes, and scores claimed. Include a checksheet for entries with more than 100 QSOs. Each entry must include a signed statement that the decision of the Contest Committee will be accepted as final. Logs will *not be returned*. Results of the QSO Party will be mailed to all entrants; an SASE is *not* required. Logs and scores must be postmarked no later than October 18th and sent to: Boeing Employees' ARC, c/o Contest Committee, Willis D. Propst K7RS, 18415 38th Ave. S., Seattle WA 98188.

SCANDINAVIAN ACTIVITY CONTEST

CW

Starts: 1500 GMT September 16
Ends: 1800 GMT September 17

Phone

Starts: 1500 GMT September 23
Ends: 1800 GMT September 24

All amateur bands from 80 to 10 meters may be used. The general call is "CQ SAC" and "CQ Scandinavia." Scandinavians will use "CQ Test" or "CQ Contest." Non-Scandinavians should try to work as many Scandinavian stations as possible. The same station may be worked once on each band. No crossmode QSOs are allowed. The prefixes used in Scandinavia are: LA/LB/LG/LJ—Norway; JW—Svalbard; JX—Jan Mayen; OF/OG/OH/OI—Finland; OH0—Aland Islands; OJ0—Market Reef; OX— Greenland; OY—Faroe

Continued on page 80

RESULTS

RESULTS OF THE 1978 MARAC COUNTY HUNTERS SSB CONTEST

Fixed Station Scores		*Mobile Station Scores*	
*N7TT/2	1,898,642	*WA0RJJ	849,176
**N7SU	986,206	*K3KX	457,306
**W7JYW	451,875	**N4UF	273,819
**W8WT	394,350	**W5VQR	216,410
**WA5DXI	385,382	**WB5BBS	191,290
**WA9MSW	332,450	**W0BK	150,600
**WB4UPW	283,024	**WA0YJL	108,186
**WB0JUS	171,120	**N5BO	43,670
**K9BG	168,041	**W1EXZ	32,844
**K9GTQ	135,080	**K9DZG	10,560
**WB4ERM	127,200	**WB8MDG	144
		W0QWS	7,655 (Check log)

DX Station Scores	
*CT1BY	19,740
**OK1DKS	2,100
CT1UA	160

*Plaque awards
**Certificate awards

RESULTS

RESULTS OF THE 1977 CALIFORNIA QSO PARTY

Single Operator Top Ten California			
W6YX (N7MH op)	1709	58	198,244
K6LL	1496	58	173,536
K6SE (WA6OYV op)	1334	55	146,740
WB6NHF	1164	57	132,696
W7CB/6	964	55	106,040
K6XO	931	54	100,548
WB6ION	865	58	100,340
K6ZM	747	56	83,664
W6TPH	705	54	76,140
N6VB	585	53	62,070
Top Ten Out of State			
K9BG	511	57	58,254
N7ZZ	488	54	52,704
K5TM (K5ZD op)	417	52	43,368
W5KLB	253	46	23,276
W3HDH	217	48	20,832
VE7DSA	218	46	20,056
WA8CZH (N8UM)	212	41	17,384
K9EG	193	44	16,984
WB0SAA	207	41	16,974
WB0PYD	199	41	16,318

This year's club competition winner is the Wireless Institute of the Northeast, which beat out second-place Mad River by only 200 points.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

ARMA could be a great boon to amateur radio if it would only stop its infighting and get its act together. We need it. There is nothing else. We face a crisis which threatens the very existence of the amateur service, and "Mother Newington" just sits and procrastinates. Come WARC '79, we had better have a well-oiled machine in the form of ARMA or we could all go down the tubes.

ARMA, the Amateur Radio Manufacturer's Association, is the best thing to come along in years. It is composed of those companies which import and/or manufacture the equipment that virtually all of us use. These are people who understand the world of big money, big business, and big politics. They have the collective ability to "bargain" for us in a way that the ARRL can never match. We need them and they need us. Together we can turn WARC '79 from a disaster into a successful exercise in international diplomatic relations. With their help, amateur radio as we know it can continue to grow and prosper.

Therefore, in the name of *all* concerned amateurs, I appeal to individuals who comprise ARMA to "bury the hatchet" with one another and work *with us* to turn the tide at WARC '79. If you want to fight among yourselves about matters not directly concerning WARC, fine. Do it in 1980. Right now, only one thing should concern you: being sure you have a market in 1980 to bicker about.

SPECTRUM MANAGEMENT

For all intents and purposes, on July 1, 1978, the Southern California Repeater Association was laid to rest. Not that it had been unsuccessful. Far from it. But thanks to the deregulation that made FM a blockbuster in a neighborhood in which it did not belong, it became evident that the day when repeaters could isolate themselves from the rest of the amateur society was long gone. In the short time since 21033's implementation, problems had begun to take shape which could easily have led to an intermode war—with FM coming up as the sure loser. Already, important ranging experiments and DX contacts on SSB in this geographic area, including an "opening" to Hawaii, had been obliterated by FMers plopping down indiscriminately to hold local rag chews. It was apparent that, as a repeater owner organization only, the SCRA could do little or nothing to help rectify this situation. However, if a way could be found to open organizational membership to all spectrum users, then a dialogue could be developed to negate such problems in the future and avoid any intermode confrontation.

At 12:30 pm on Saturday, July 1, Chairman Paul McClure WA6HGK called to order what was to be the last SCRA meeting under its old format. By 5:00 pm, when the meeting ended, the structure of the SCRA had been reorganized into two parallel total spectrum management organizations, one each for two meters and 220 MHz. Membership in either organization is open to all interested spectrum users (the 2 meter organization has the minimal limitation of a Technician class license, while the 220 organization requires only an amateur license). In either organization, all members carry voting privileges. The 220 organization is named the Southern California 220 Spectrum Management Association ("SMA-220" for short), and its interim president is Bob Buaas K6KGS. For the moment, the 2 meter organization has retained the SCRA logo (with the additional Spectrum Management tag added on). This will shortly change, probably to SMA-144 or something along those lines. Both organizations intend to incorporate. In addition, dues have been cut in half, so if one's interest is in one band only, he only pays half of what he did before (while if his interests are twofold, his personal dues structure remains the same).

Attending the meeting were not only repeater people, but also representatives from other non-relay modes, including a three-member delegation from Sidewinders On Two's southern California chapter. Even a guy claiming to represent AM interests showed up. The vote was close, but in the end the forward thinkers prevailed and restructuring became a reality. For the first time, a repeater council had changed its character to welcome input from all areas of amateur operation on VHF.

DISSENT?

While many spectrum users seem elated at the results of the restructuring, there are some who are very disturbed at the outcome. This seemed obvious from the lack of attendance at the meeting by a good number of two meter repeater owners, even though the meeting was announced in *HR Report* and on the Westlink taped newscasts. The 220 MHz people showed up en masse, but two meter participation was obviously lacking.

It is no secret that many of what I term "old-line" repeater owners feel that no one other than themselves should have any say-so in the matter of council operations. In the past, the question of non-owner voting participation had been voted down, usually after heated and emotional debate. It usually lost by a large majority—a vote carried by the two meter faction. However, at this meeting no such voting bloc was on hand, so a coalition of the "new line" two meter people and the 220 owners carried us into a new era. What, if anything, the old-liners will do to show their displeasure is unknown, but rumors are running rampant about the formation of a new owner-only organization to challenge the new dual SCRA/SMA 220 structure. I hope this doesn't happen, because owner/user relations are already quite strained.

DECENTRALIZATION OF GOVERNMENT

Government? Well, that's as close a term as I can come up with right now, so it will have to do. In this case, the term is being applied to the "Centralized 2 Meter Technical Committee," a committee which I currently happen to chair on an interim basis for the SCRA. If you never get the chance to serve in a position such as this, consider yourself lucky. It's a nightmare and a headache. However, there are rewards which make it all worthwhile, such as those times when you are able to prevent a "brushfire" dispute from erupting into total warfare, and the few and far between ones when you send out a coordination letter and receive a written thank-you note.

Anyhow, something recently occurred to me, something which I hope to try out here to help minimize coordination problems. When you have a single central committee (or individual coordinator) handling everything, the work load can be unbelievable—even for a committee which meets bimonthly like ours does. Is there a better way? Maybe, but perhaps not one which would be applicable everywhere. The reason? Terrain.

In southern California, most repeaters sit on high places such as mountains and serve users in low(er) places. Because of their altitude, it would seem that our repeaters' ranges would be almost limitless. Not so. Mother Nature has placed other mountains in strategic positions and has seen fit to make them inaccessible enough to make their use as potential repeater sites impractical. Until solar power on a truly operational scale becomes a reality, they shall remain untouched. Thanks to these "bumps," southern California is approximately divided into four geographic zones. They are the high desert, the low desert, the Ventura/Santa Barbara and inland area, and the Los Angeles/San Diego rf corridor.

Rather than have one central committee handle everything, I hope to institute a regionalized subcommittee structure in which several smaller regional committees could handle the needs of the local amateurs by investigating the technical aspects of an intended relay operation and making a recommendation as to which channel pair offered the best chance for minimal environmental impact—i.e., interference to existing operations. While I may know what I can hear in the LA area, Santa Barbara is a whole new ball game. A regional technical subcommittee could do far better than a group of Angelinos or San Diegoites or high desert people in coming up with a viable operation. However, to delegate such duties could result in chaos if there were not some form of control, and here is where the Central Technical Committee comes into play. The regional subcommittees will make recommendations based upon what they determine is best suited to the area's needs, but all such recommendations will be reviewed by the Central Committee prior to implementation. If all looks copesetic, then it's only a matter of saying "yes" and sending out the letter. However, if something exists in another geographic area that experience has shown to be a no-no, it is hoped that such will be caught by the Central Committee before disaster strikes. In this way, the self-determination of a given area's setup can become a viable part of the overall coordination process, and no one need ever feel that he or she has been left out of the process.

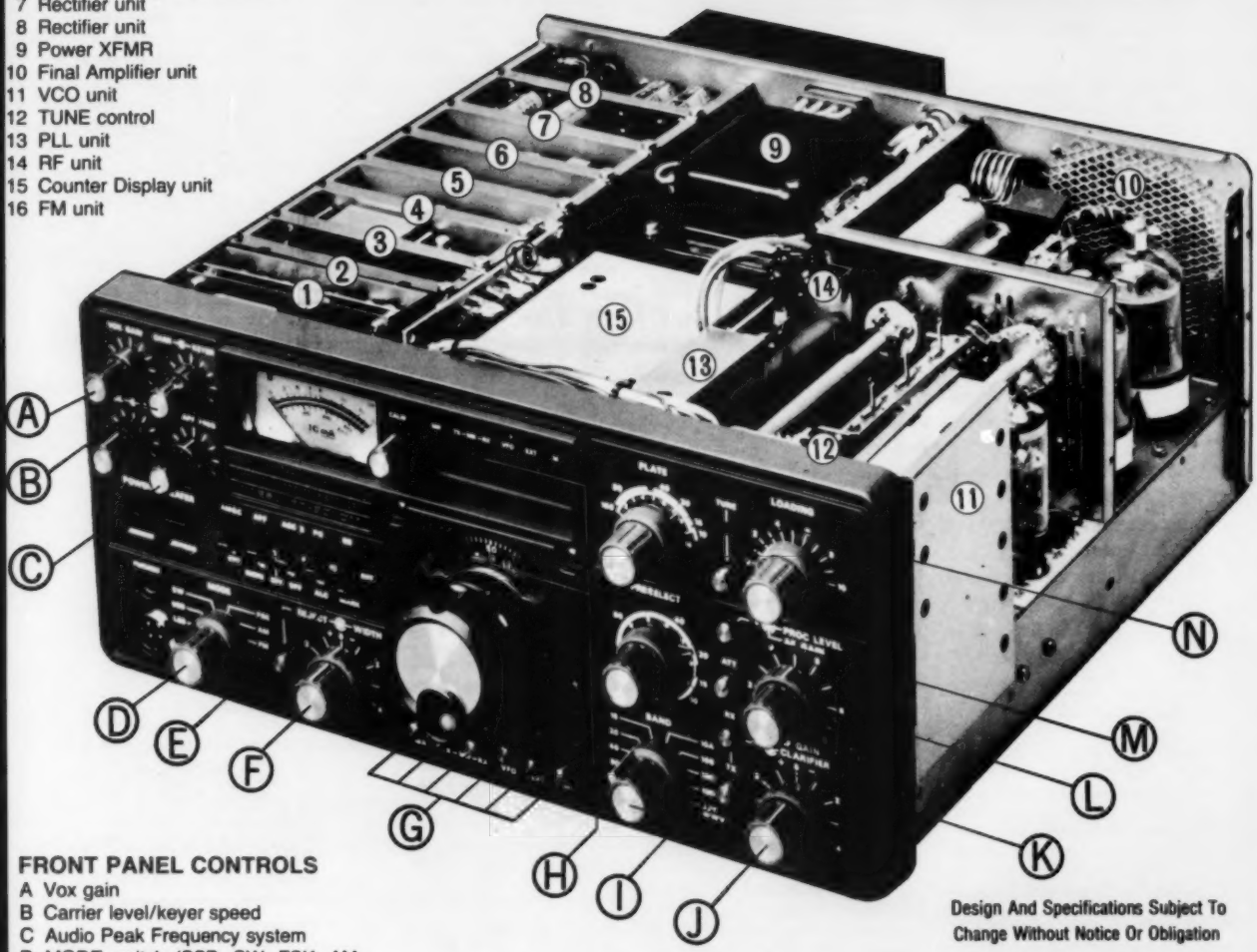
I don't know if it can be made to work. I do think that the idea holds merit and is a viable alternative to having a myriad of councils, each duplicating the other's work. Any opinions?

Continued on page 77

BOARDS INSIDE CABINET

1 CARR OSC unit
2 VOX unit
3 AF unit
4 IF unit
5 Filter unit
6 Noise Blanker/RF Processor
7 Rectifier unit
8 Rectifier unit
9 Power XFMR
10 Final Amplifier unit
11 VCO unit
12 TUNE control
13 PLL unit
14 RF unit
15 Counter Display unit
16 FM unit

FT-901DM



FRONT PANEL CONTROLS

A Vox gain
B Carrier level/keyer speed
C Audio Peak Frequency system
D MODE switch (SSB, CW, FSK, AM, FM)
E Crystal calibrator/Noise blanker
F Rejection tuning/variable IF passband tuning
G Frequency memory system
H Digital plus analog frequency readout
I Band switch (160-10 meters + WWV/JJY receive)
J Clarifier control
K RX/TX Clarifier selector
L RF Processor level
M RF attenuator
N TUNE control (Places transmitter in "TUNE" condition for ten seconds, then returns to "receive" condition to protect final tubes from excessive key-down time)

Design And Specifications Subject To Change Without Notice Or Obligation

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RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Labor Day is upon us, and the kids are starting back to school. Time to start paying attention to those problems which have been bugging us all summer, but that we've been putting off 'til fall!

For those of you who own mechanical TTY machines, when was the last time you cleaned and lubricated the beast? I know, Teletype™ built them to run for years, but a dose of benign neglect can shorten their life expectancy dramatically. If you have a Model 15 or 19, lubrication should not take more than a half hour, and your machine will thank you!

Let's start with the outside. Wipe the cabinet down with a damp cloth, and spray some glass cleaner on the little window. If yours has a black crinkle finish, some black liquid shoe polish, such as Griffith, will do wonders to restore the "new" look. Other finishes, such as my green crinkle, respond nicely to some paste wax. Check all the wires and cables for signs of fraying or loose connections. Now, lift off that cover and peer inside.

Basically, there are three types of lubrication points in a Teletype machine: oil cups, felts, and sliding contacts. The first two require a good grade of oil, the latter a good grease. I have found that the most available and economical oil is plain old 10W-30 motor oil. Intended for the family car, and frequently available at discount houses, it normally is priced under a dollar a quart. The grease most used by TTY enthusiasts is Lubriplate®, although any good grease such as auto grease (*not* Brylcreem®!) should work well.

Now that you have the cover off, and the machine unplugged, hopefully, unscrew the three large bolts which hold the printing unit on, and the two holding the keyboard in, and break the unit down to its component parts. Turning first to the base, wipe up any accumulated oil or grease, and clean away the typical gunk around the motor. While you're there, look for the ball bearing on each end of the motor shaft. These are oil points. Depress the ball bearing with the spout of your oil can and deposit a large drop of oil therein. If it has been a while since you've done this (or perhaps this is the first time), rotate the motor by hand for a bit, then do it again! Put a small dab of grease on the pinion gear—that's the one on the motor shaft. Finally, clean all contacts on the base and tighten the screws on the terminal block.

The keyboard gets our attention next. First off, look at the row of contacts that produce the pulses. Are they all gooky and covered with a paste of dust and oil? *Clean them*! Use a piece of bond paper and lightly burnish the contacts, too. Check all the springs on the underside of the keyboard for proper seating, and straighten or replace damaged keytops. Now, look at the top of the keyboard. Next to the gear is a small cup, set at a right angle, with a spring-loaded, hinged lid. This is the first of several oil cups we will be filling. They all look the same. Lift the lid and fill the cup with oil. Follow the shaft back to the contact area and you'll find five felt washers between metal surfaces. These are called "felts" and act as oil soaked pads between rotating metal surfaces. Depending on the age of your machine, and your aggressiveness in servicing it, they may be grayish-brown or dark and oil-soaked. If they are not soaked, soak them! Just dabble on oil while rotating the shaft manually until they look saturated, then wait 30 minutes and do it again. Some replenishment drops will do if they look pretty good.

While you set the keyboard aside to let the oil soak in, turn your attention to the printer. Again, clean the contacts and get all the accumulated gunk off everything. If your wife (or mother) will let you, and the accumulation is not too greasy, a vacuum cleaner with a circular brush attachment works wonders in de-linting nooks and crannies. Now, look along the main shaft and fill the three oil cups. Also, notice the felts interspersed. Saturate them the same as you did on the keyboard. Don't forget the felt on the selector magnet assembly!

The next step depends on your familiarity with the machine. We want to take off the typing basket and clean it and the rails and vanes. To accomplish this, place the basket on the far right-hand side by first depressing the manual carriage return level, and, while holding the basket immobile, slide the basket to the extreme *right*. Depressing the dashpot lever should lock it in position. Now, firmly hold the drum which winds the carriage return band while removing the band from the rear of the typing basket. Hook the free end over the end-of-line bell lever. Now re-press the carriage return lever, which should allow the basket to move freely back and forth, and flick the stop lever on the underside. The typing basket should now slide freely off the rails, into your waiting hands, on the right side. Clean all the keys thoroughly, and get the dust and paper bits out of the basket. A small drop of oil on the ball bearings will keep things rolling along, singing a song. While the basket is off, wipe down the vanes and apply a thin layer of grease here. In fact, apply grease to all sliding surfaces, and a little dab to gear teeth, too. Now, *carefully* reverse the sequence of the previous directions and replace the typing basket. Make sure all the forks correctly seat on the vanes at the front of the machine. Also, be sure the basket is locked with the dashpot *before* you re-attach the carriage return band. If you have any difficulty understanding these admittedly sketchy instructions, or have never removed the typing basket before, *DO NOT* attempt it! Either ask someone who has done it to help you, or clean it as best you can without removing it. While it sounds simple enough to do, and it really is, one slipup can totally disable a working machine.

Now put everything back together. Hopefully you haven't any extra pieces left over. While you're at it, check out the ribbon. Is it getting worn to the ragged end? If it is not too old, simply turning it over, by reversing the spools, may bring new contrast to your print. Otherwise, be a sport and replace it. If you don't have a new one, pay a visit to your local drugstore. Any ribbon listed as a replacement for the Underwood Standard will fit. This is usually Number 1 in most replacement lines.

Follow this procedure carefully twice a year, and your machine should have a long, happy life.

A letter turned up in the mailbag from Steve Alexander WD6EQP of Vallejo, California, who enclosed a photo of his "mystery" Teletype. Well, Steve, this is the AN/UGC-20, also known as the "compact" Model 28 KSR. It is a fine machine, but I will admit that it is not as frequently covered as the 15/19 in ham literature. So, next month, I will take a look at the Model 28 and pass along what I can about this beautiful machine.

Quite a bit of response has been heard on the computerized RTTY covered in June and July. More importantly, WD6EQP's letter brings to light the diversity of equipment presently in use on RTTY. I would be interested in compiling some data on just what our readers are using. I invite each of you to send me, on a postcard or QSL, the stats on what kind of RTTY gear you are running, if you have a computerized station setup, what kind of CPU, memory requirements, and perhaps some idea of the program. Send along your information to me at the address shown, or in care of *73*; they will forward the cards to me. I'll try to make some sense out of it all and let you know what's what in a future RTTY Loop.

AMSAT

OSCAR SATELLITE PHOTOGRAPHS

Full color 8" x 10" photographic prints are available of WA6TUF's artist illustrations of AMSAT-OSCAR 7, AMSAT-OSCAR 8, and AMSAT Phase III for $3.25 each. Also available are custom-painted 16" x 20" duplicates of each illustration. AMSAT-OSCAR 7 is $100, AMSAT-OSCAR 8 is $80, and AMSAT Phase III is $125. Write: Mike Smithwick AA6XI (ex-WA6TUF), 25215 La Lome Drive, Los Altos Hills CA 94022.

Ham Help

I want a copy of the instruction manual and/or schematic for the CDE/CDR TR-4A or TR-11A (series 12307) antenna rotator. Thank you.

M. McDaniel W6FGE
940 Temple St.
San Diego CA 92106

I would sure like to get in touch with Sgt. William "Scotty" Scott ex-DL4ZD. We sort of got out of touch after we both retired.

Russell L. Lawson K1MOU
124 South Grand St.
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New Products

KANTRONICS FREEDOM VFO

Sitting unused in shacks, on closet shelves, in attics, cellars, and garages all over the country are thousands of perfectly good transmitters in the 20- to 200-Watt range. Why are they collecting dust instead of QSOs? Because they are crystal controlled. On today's crowded bands and with current operating practices, using a crystal-controlled transmitter and a few crystals can be a very tedious and unproductive way to operate. Gone are the days when (as I once did) with as little as 30 Watts and three or four crystals, you could work the world with relative ease and regularity. (I ended up with over 120 countries worked on 10 and 15 meter CW with a base-loaded vertical mounted on the side of the house.)

Those days may be gone forever, but there is no need to let those otherwise perfectly good rigs lie unused, especially in view of the current prices for new equipment. With the addition of a good vfo, all those old Heath DX-20, DX-35, DX-40, HW-16, WRL Globe Chief, Globe Scout, Johnson Viking, and countless other rock-bound rigs can still provide years of good service and lots of QSOs.

Happily, Kantronics' Freedom VFO is just what the doctor ordered. Add it to one of those old "boat anchors" and you'll be ready for action. And, perhaps best of all, you may end up spending only the affordable price of $69.95 for the vfo since the old rigs can often be had for the asking. The unit covers 3.65 to 3.75 MHz and 7.0 to 7.2 MHz. Operation on 15 meters (21.0 to 21.2 MHz) may be possible with the band-switch in the 40 meter position if the transmitter's buffer stage acts as a frequency tripler. Power for the vfo may be furnished by a single 9-volt transistor radio battery or a well-regulated 12-to-15 V dc supply. Current requirement at 9 V dc is 8 mA.

Dial markings are every five kHz on 80 meters, and every 10 kHz on 40 meters. The vernier dial works smoothly and has a good feel. In view of the rather sparse dial calibration points, it would probably be a good idea, as well as reassuring, to use the Freedom VFO in conjunction with a receiver with an accurate frequency calibration source such as Kantronics' The Standard. All of the components of the vfo's two-transistor circuit, except for the tuning capacitor, switches and connectors, are contained on a single small PC board solidly mounted to a heavy piece of aluminum which is secured to the bottom of the cabinet.

The Freedom VFO was tried with the Kantronics Rock Hound 1-Watt 40 meter transmitter and a vintage tube-type home brew transmitter, providing good results with both units. The CW note sounded good and clean when monitored on a Yaesu FT-101B, and signal reports were all T9. Vfo output is 2 milliwatts (1 volt peak-to-peak).

Packaged in an attractive black and gray cabinet, the Freedom VFO measures 3 x 5 x 7 inches. Price is $69.95. *Kantronics, Inc., 1202 East 23rd Street, Lawrence KS 66044.*

Morgan W. Godwin W4WFL
Peterborough NH

GENAVE GTX-800 2 METER TRANSCEIVER

Genave's GTX-800 2 meter FM transceiver created a good impression when the first four contacts made with it produced such unsolicited comments on its signal quality as "beautiful, really outstanding audio," "excellent modulation," "sounds great . . . much better than your other two rigs," and "terrific-sounding signal." Subsequent QSOs have resulted in many more favorable comments on the GTX-800's signal. In fact, it's been downright embarrassing when I've compared the Genave with two other 2 meter transceivers: one, a rather expensive HT of excellent quality, the other, one of the leading multi-mode units. On their own, the other two rigs have always produced good results and received favorable comments on signal quality. However, the GTX-800 outstrips them in audio quality and, when in the 1-Watt (nominal) position, it appears to do about as well as the multi-mode rig does with approximately 10 Watts.

With its coverage of the entire 144-148-MHz range, the GTX-800 provides coverage of the new U.S. repeater subband as well as repeater frequencies in Europe and elsewhere, making it a good choice for the amateur who travels. A VHF, dual-modulus, prescaling, digital, phase-locked-loop synthesizer gives access to 800 channels from 144.0 to 148.0 MHz.

On transmit, the voltage-controlled oscillator (vco) output is on the desired operating frequency with no multiplication. In the receive mode, the vco output frequency is raised by 10.7 MHz, again with no multiplication, to reduce the possibility of spurious responses. Interference from strong signals on adjacent channels is minimized by a 10.7-MHz, eight-pole monolithic crystal filter and a MOSFET receiver front end.

A front-panel mounted meter indicates relative signal strength for signal comparison, antenna adjustments, etc., when in the receive mode; in transmit, the meter indicates when rf power is being delivered by the final amplifier stage.

A two-position switch mounted on the front panel selects either high or low transmit power. In the high-power position, transmit power is typically 25 Watts (20 Watts minimum). With the switch in the low position, power is reduced to 1 Watt (0.5 Watt minimum). The low-power position is internally adjustable up to approximately 5 Watts.

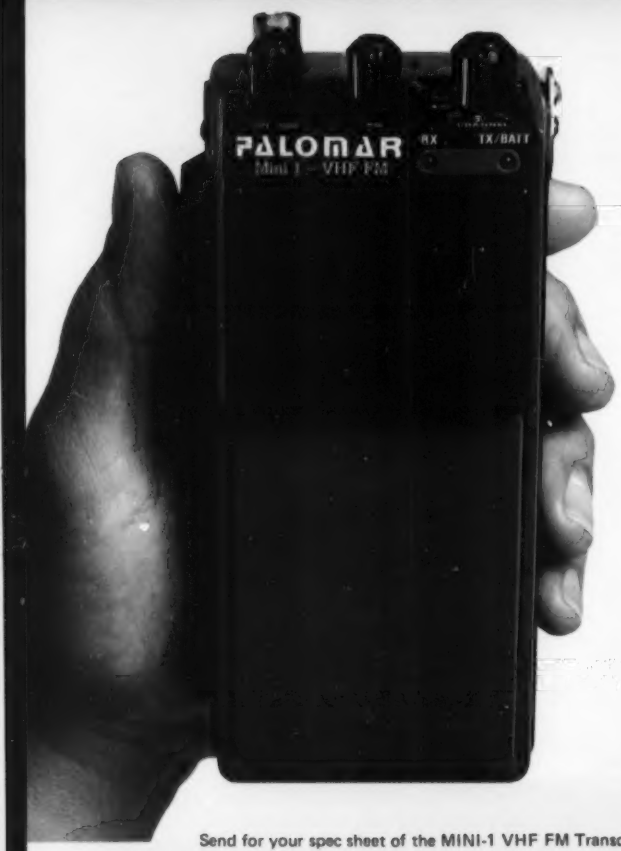
An "out-of-lock" circuit with a red LED indicator is provided to let you know when the synthesizer is unlocked and to disable the transmitter during an "out-of-lock" condition. The LED goes on when the synthesizer fails to lock on frequency. In this event, the transmitter is locked out to prevent inadvertent operation on an unauthorized frequency such as below 144.0 or above 148.0 MHz.

Frequency selection is made with the three front-panel-mounted frequency selector lever switches. These three switches select and display the desired transmit frequency. The left-hand lever selects unit MHz frequencies (144, 145, 146, 147, and 148). The center lever selects tenth-MHz frequencies from .0 through .9. The right-hand lever selects ten kHz frequencies from 0 through 9. For example, 146.600 MHz would be displayed on the lever switches as 6.60 while 146.930 MHz would be shown as 6.93.

A receive-mode switch selects either simplex or +600- or -600-kHz offset for repeater operation. The kHz-frequency switch has two positions, 0 and +5. In the +5 position, 5 kHz is added to the frequency set by the lever switches. As an example, with the lever switches set to 6.60

Kantronics' Freedom VFO.

The Genave GTX-800 2 meter transceiver.



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and the kHz switch set to +5, the actual transmit frequency is 146.605 MHz. The +5 position also adds 5 kHz to the receive frequency. With the switch set in the 0 position, frequency is as indicated by the three lever switches.

The GTX-800 comes with microphone, power cable, and mobile-mounting bracket. The mobile mount may, if you wish, also be used for fixed-station operation by simply repositioning it below the unit so that it functions as a "tilt-type" supporting stand. Current requirements in the transmit mode are 2.3 Amps in the low-power position and 6.5 Amps for full (25 Watts) power. Genave makes a suitable ac power supply, the model PSI-10, for fixed operation of the GTX-800. Overall size is 3-3/8" × 9-3/4" × 12"; weight is approximately 6 lbs. It is priced at $399.95. *General Aviation Electronics, Inc., 4141 Kingman Drive, Indianapolis IN 46226.*

Morgan W. Godwin W4WFL
Peterborough NH

500 WATT RF TRANSFORMER

Palomar Engineers has introduced a new broadband rf transformer. It matches vertical and mobile antennas to 50-Ohm coaxial cable. Impedance values of 8, 12.5, 16, 22, 32, and 50 Ohms are selected by a panel switch.

The transformer is mounted in a diecast aluminum case 4" x 5" x 2" fitted with UHF (SO-239) connectors. The rf ferrite toroid core is wound with Teflon™ insulated wire and is rated 500 Watts in continuous commercial service. Operating frequency range is 1 through 30 MHz (1 through 10 MHz below 20 Ohms).

The price is $35. Add $2 shipping in U.S. and Canada. For free descriptive brochure, write to *Palomar Engineers, PO Box 455, Escondido CA 92025.*

NEW DPMS FROM NLS FEATURE NEMA/DIN CASES AND LARGE LCD OR LED READOUTS

A new RM Series of Digital Panel Meters has been added to the NLS Thriftmeter DPM line.

The RM Series fit standard NEMA/DIN cutouts. Readouts can be either .6" high LCDs or .5" high LEDs. Electrical connections to meter can be made by PC edge connector or, for industrial users, terminal connections are supplied, depending on the model number ordered.

The RM Series meter case is 1.9" high by 4" wide by 4.2" deep.

The basic RM Series meters are powered by 5 volts dc primary power and measure dc voltage. They will also be made available in configurations that provide the capability of measuring ac voltages and/or being powered by 115 V ac power.

LCD models draw only .002 Amp at 5 V dc.

The basic RM Series meters bear model numbers RM-350 for the LED version and RM-351 for the LCD model. Adding TB to the model number designates terminal connections. /AC specifies an ac input, while /115 specifies a line-powered unit.

Voltage ranges available are .2, 2, 20, 200, and 1000 volts full scale. The .2 V range is not supplied for ac inputs.

Dc accuracy is .1%. The RM meters utilize the latest in LSI chips, which contributes to a low component count and best reliability.

The prices for RM meters start at $59/unit selling price. Quantity discounts make them cost effective for OEM users.

RM-350 and RM-351 are currently available from local electronic distributors worldwide. For details, contact *Non-Linear Systems, Inc., PO Box N, Del Mar CA 92014; (714)-755-1134.*

NEW HAMTRONICS 2 METER CONVERTER

A recent rekindling of interest in 2 meter operation, plus a growing curiosity about OSCAR satellite activity, happily coincided with the opportunity to try one of Hamtronics' new C144 receiving converters. Connected to my FT-101B, the converter outperformed my multimode 2 meter rig by a very clear margin. The converter was received in assembled form but a visual check left me with the impression that even a relatively slow worker such as myself could put one together without difficulty in an hour or two. As explained in their catalog, Hamtronics' kits are not accompanied by the meticulous step-by-step instructions and illustrations provided, for example, with Heathkits®. However, anyone who has even a modest acquaintance with home brewing or kit building will find that construction is simple and straightforward.

The C144 covers the 144-146-MHz portion of the 2 meter band while two other versions, the C145 and C146, cover the 145-147 and 146-148 segments. Standard i-f frequency for the converters is 28-30 MHz. By the way, crystals can be switched to cover multiple band segments, if desired. (Extra crystals for other ranges in the same band are available for $5.95.)

Features of the new design, which replaces Hamtronics' popular C25 series, include easy-to-wind high-Q slug-tuned coils, extensive ferrite bead

Palomar Engineers' rf transformer.

RM Series LCD (top) and LED (bottom) Digital Panel Meters.

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See Ward W1WRQ – John W1JJR

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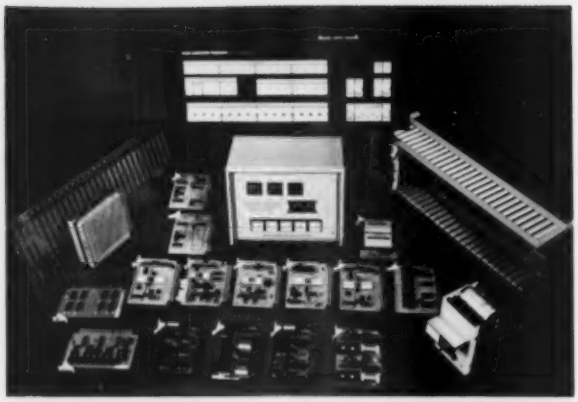
decoupling and compartmentalized shielding, as well as built-in detector circuits for simple injection-chain tuning. Stable, grounded-gate FET amplifier and mixer stages contribute to the converter's excellent performance. Alignment requires only a strong signal source and a VTVM and can be accomplished in a few minutes.

Measuring 2¾ x 4½ x 1 inches, the converter board can be mounted in existing equipment, or a separate case of your own design, or Hamtronics' model A9 Case Kit. The case kit is a 2-7/8 x 4-5/8 x 2-inch extruded box with an attractive brushed aluminum finish. The top panel is machined for BNC jacks which are included, as are phono plugs and cable for connection to the converter board.

The C144 and its other 2 meter versions are just one example of an extensive and growing line of receiving and transmitting converters, exciters, amplifiers, preamps, and other items for the VHF/UHF enthusiast. If you've got an HF rig and are contemplating satellite operation, you'll certainly find Hamtronics' complete line of modules and accessories an excellent way to get in on the OSCAR fun and excitement with a setup that combines flexibility, simplicity, ease of construction and alignment, high performance, and modest cost.

Price of the C144, C145, and C146 2 meter receiving converter kits is $34.95. The A9 Case Kit is $12.95. A new free catalog describing the complete Hamtronics product line plus many other items including hard-to-find components is available on request. All Hamtronics products are available from *Hamtronics, Inc., 182 Belmont Road, Rochester NY 14612.*

Morgan W. Godwin W4WFL
Peterborough NH



Wyle's digital logic modules.

SINGLE IC FOR KEYBOARD KEYER

A single IC containing most of the electronics for a deluxe keyboard keyer has been introduced by Curtis Electro Devices. Called the 8045, the 40-pin CMOS device uses one or more FSC 3341s, a Curtis 8043 or 8044 keyer, and a set of keyswitches to produce the equivalent of the Curtis KB-4200 keyboard keyer *including* an electronic paddle keyer. By adding the new 8047 Message Memory Control IC, 2102 RAM, and a 4028 CMOS decoder, the equivalent of a KM-420 memory is added.

The 8045 allows a nominal fifty-seven position keyboard containing all the commonly used letters, figures, punctuation, space bar, and special characters (AA, KN, AS, SK, AR), all without shifting. It affords two-key rollover for "burst" typing; 32-, 64-, or more character storage for smooth transmission; access to four message memories via buffer; analog output for buffer status meter; full- and empty-buffer indication, plus a preload function. It operates from +5 V dc and requires less than 10 mA of supply current.

Priced at $59.95 in single quantities, the 8045 is available from stock. A semi-kit (8045-1) containing the 8045, 3341, PCB, sockets, and edge connector is priced at $89.95. (The 8044-4 keyer semi-kit is priced at $54.95.)

For further information, contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040; (415)-964-3136.*

DIGITAL LOGIC MODULES

The Wyle line of digital logic includes over 200 modules covering all types of logic elements. Available on the 3¼" x 4½" modules are gates, flip-flops, decoders, counters, one-shots, line drivers/receivers, electronic switches, and many more. Additional modules include relays, test-point modules, extenders, lamp, toggle switch, and a wide variety of socket, wire-wrap, and blank modules. Also available are card files and card drawers for rack-mount or custom installations and logic power supplies.

The Wyle logic line is also fully compatible with the Wyle uP Series microcomputer.

For additional information, contact *Wyle Laboratories/ Computer Products, 3200 Magruder Boulevard, Hampton VA 23666; (804)-838-0122.*

CSC DM-1 DESIGN MATE® COMBINES SOLDERLESS BREADBOARD, METER, AND POWER SUPPLY FOR ELECTRONIC LAB STUDY

The Continental Specialties Corporation Model DM-1 Design Mate® provides the three elements most basic to electronic circuit investigations—a power supply, breadboarding area, and meter—in one convenient package for $69.95.

The meter measures 0-15 V dc (5% accuracy) and is independent of the power supply, with leads brought out to a pair of five-way binding posts. Thus, the meter can be used to set the adjustable power supply's voltage, and then to monitor circuit action.

The built-in power supply is adjustable from 5-15 V dc output at up to 600 milliamps, with better than 1% load and line regulation and less than 20 mV ripple and noise at full load.

The solderless breadboarding area is configured from CSC QT-series ("Quick Test") socket and bus strip elements. It provides enough area to comfortably breadboard a circuit with 6 DIP ICs, plus associated components.

The compact 3 pound DM-1

Continued on page 37

The Curtis 8045 keyboard keyer.

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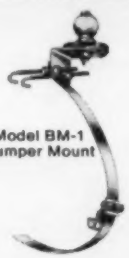
Model SSM-2 Ball Mount

Model QD-1 Quick Disconnect

Model RSS-2 Resonator Spring



Model BM-1 Bumper Mount

Model L-14-240 Mil Spec 50 Ohm Feedline

Model MO-2 For Bumper Mount Location

Model MO-1 For Deck or Fender Location

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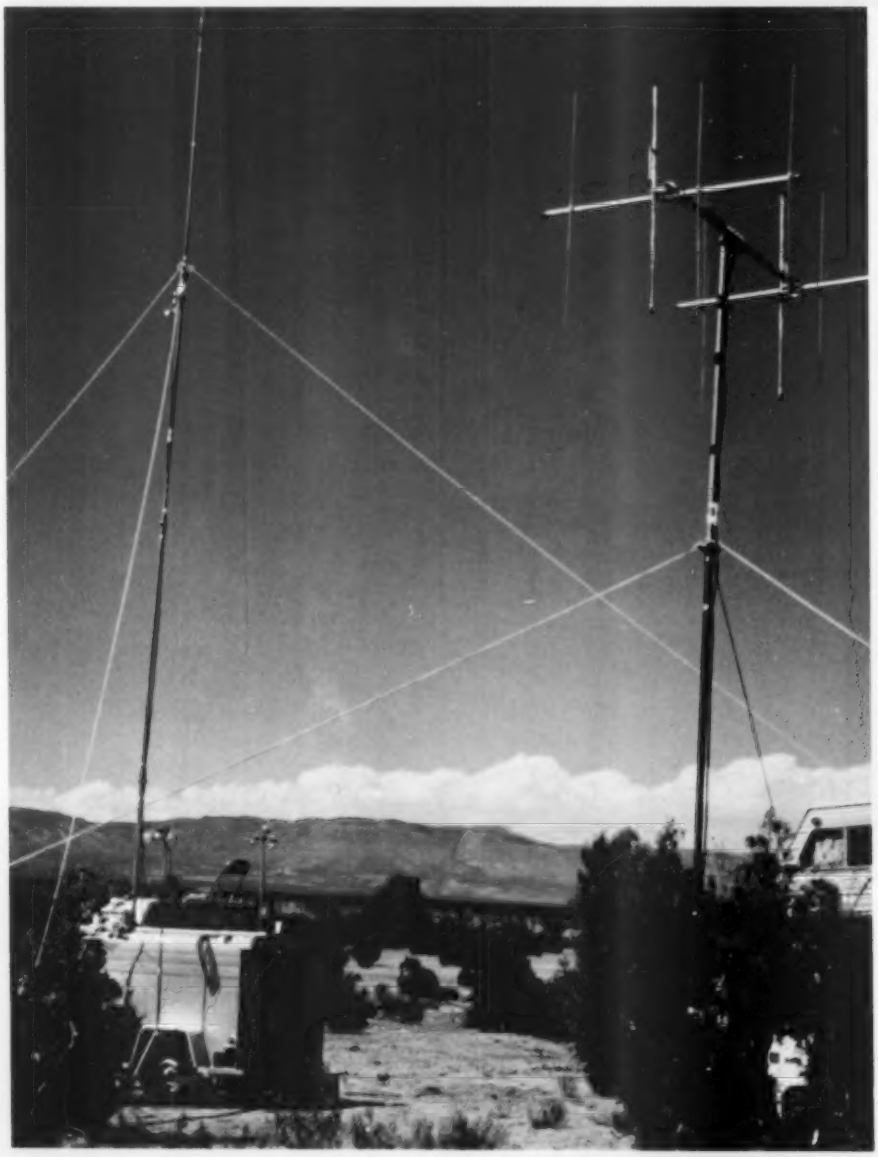
Four-Wheel Frenzy!

Hams and the Baja Internacional



Antennas at El Rodeo, checkpoint six.

June and November are special months to many hams in Mexico, California, and other western states. From many areas, they converge on San Diego or Mexicali for points south. They come in cars, 4-wheel drive vehicles, luxurious motor homes, trucks, and airplanes. It's Baja time! Baja 1000 and Baja Internacional have become everyday words in many ham shacks. XYLs know it's time to pack up supplies and camping gear, and the harmonics look forward to three or four days of fun and freedom in the friendly XE2 land.

During the late 1950s, the first automobile drove over 900 miles of the rugged, rough, and rocky Baja Peninsula from Ensenada to La Paz. The drivers made their own route where there was none. Racing began over the route from Ensenada to La Paz in 1965. These early events were loosely organized. However, from the beginning, radio amateurs operated portable stations along the way, relaying information and keeping track of the racers' safety. The amateurs drove incredible roads to camp in lonely, wildly beautiful spots. They erected portable antennas, brought their own generators, and experienced hurricanes, torrential rains, dust storms, hot, humid days, blizzards, and cold shivery nights, never failing to provide the type of communications for which

amateur radio has become famous.

Although the early Baja races were from Ensenada to La Paz, completion of Mexican Highway 1 along the old route necessitated establishing a new course in the early 1970s. The new route was a loop instead of a line which terminated in La Paz, 1000 miles south of the United States border. Recent races have started and ended in Ensenada.

About the same time as the course was changed, in 1972, the Southern California Off-Road Enthusiasts (SCORE, Int.) was organized by Mickey Thompson, a top racer, to sponsor future events. In 1975, Sal Fish, former publisher of *Hot Rod Magazine*, became president of SCORE, Int. Under Sal's leadership, SCORE has grown even stronger. Each event sees increased participation and interest. SCORE has improved relations and negotiated long-term agreements with the Mexican government to insure the future of off-road racing on the Baja Peninsula.

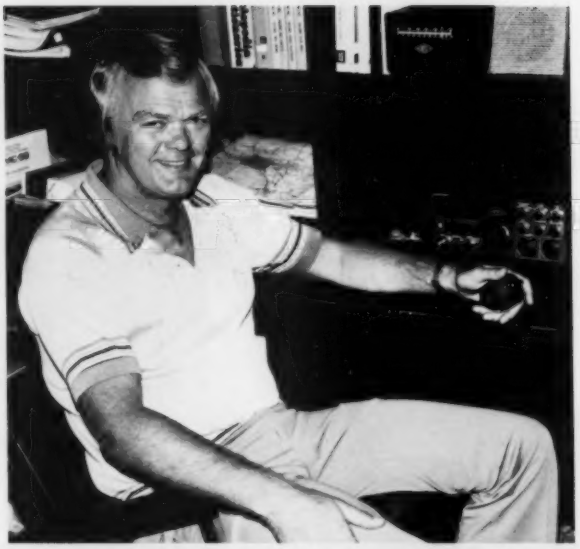
During this period of off-road racing's development, the amateurs who participated in these events formed an unofficial organization which became known as the Baja Amateur Racing Fellowship, or BARF. BARF was soon changed, for obvious reasons, to the Baja Amateur Radio Racing Association, familiarly known as BARRA.

Early communications used HF SSB amateur bands. The first use of VHF FM for an off-road racing event was in 1975 when the Anaheim Amateur Radio Association provided communications for the Big River 400 race out of Parker, Arizona, on 146.52 MHz simplex. VHF FM and VHF repeaters have been used for all races since, as well as HF SSB.

The 1977 Baja Internacional was the largest off-road race in history with approximately 450 entries. They ranged, in eleven classifications, from motorcycles to 4-wheel drive trucks. All competed over the same course for overall honors, as well as for individual classification awards.

Extensive communication circuits are necessary to handle the volume of traffic for such an event. Amateur radio stations using the callsign XE2BCM are authorized by the Mexican government to provide communications for the duration of the race. These operations are coordinated with the Mexican National Radio Amateurs and the Liga Mexicana de Radio Experimentadores, A.C. BARRA wishes to extend special thanks to the members of the Ensenada Radio Club, owners of the fine 146.22/.82 repeater in Ensenada, who graciously allowed its use for interunit communications while the BARRA network was being installed.

This network was designed to provide up-to-the-minute vehicle passing times at each numbered checkpoint directly to Ensenada Race Control. Passing times are computed, and the standings of the leading racers are continuously available.



WA6GQF coordinated race communications.

Portable stations were located at the start/finish line, Ensenada Control, and seven major checkpoints. Two aircraft and five off-road mobiles provided communications from any section of the 430-mile course and to the paramedic teams.

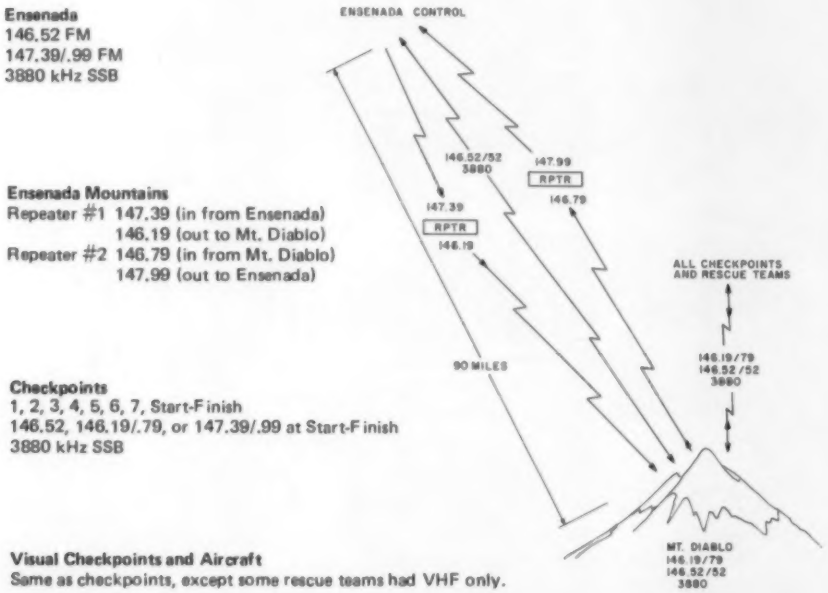
The race course climbs rapidly after leaving the starting line, going over the mountains, past Ojos Negros, to the first checkpoint at El Rayo, which nestles in lovely high mountain pine groves. There it turns south through the ruins at Santa Caterina before challenging the formidable Sierra de Juarez. It soars over rugged Jamalu Summit and descends rapidly to the hot sandy desert, passing checkpoints 2 and 3 as it continues to the picturesque seaport city of San Felipe on Baja's

K6WS reports injured driver's condition to Ensenada Control.

Racers passing Nuevo Junction.

eastern coast. Most of the racers make a pit stop in San Felipe before departing to the west into the dry barren Laguna de Diablo. The foothills of Picacho del Diablo are a welcome relief after several hundred miles of dusty desert. The course steers through Mike's Sky Ranch, the road stretches out, and the race for Ensenada is stepped up. Once past checkpoints 6 and 7, the racers challenge the mountains guarding the finish line at Ensenada.

Many vehicles fail to finish. A simple form called a "stuck stub" is carried by each driver. If disabled, he sees that his stuck stub is delivered to the officials at the next checkpoint, where the information is transmitted to all stations. Officials and racing teams can keep track of their entries by periodically checking the posted stuck stubs.



Baja Internacional communications system.

Trained paramedics stationed at the checkpoints are dispatched by the chief paramedic through the radio network. Mobile units can accompany the paramedics to provide communications directly at the scene of an accident.

This year, more than fifty members of BARRA and their families made the long trek to the remote areas of Baja. Hundreds of hours of planning had already gone into preparing for this event. BARRA's technical committee had completed three new VHF solid state repeaters using Motorola components. They are designed for unattended battery operation because of a blizzard during last November's Baja 1000 which forced the repeater crew to evacuate Mt. Diablo with the vacuum tube repeater and 5 kW generator, leaving the network to function on the HF SSB circuits only.

All stations have emergency power sources provided by the amateurs. Ensenada Control used its own standby generator extensively during the 1975 Baja Internacional when a helicopter hit power lines and caused a sustained power blackout in the city.

BARRA obtains the necessary practice to achieve and maintain a high level of emergency preparedness by providing routine communications to organizations such as SCORE. Each event generates different solutions to difficult communication problems, and experience enables BARRA to become more efficient. This is important to the achievement of BARRA's primary objective of being able to establish and maintain an organized communications system during emergencies to assist law enforcement and relief agencies.

Net control was located at the Baja Internacional Race Headquarters at the Bahia Hotel in Ensenada. The 75 meter SSB transceiver used an inverted vee antenna. A 22-element beam and 100-Watt

VHF FM transceiver provided direct communications with Mt. Diablo 100 miles away.

A solid state repeater with a vacuum-tube backup was installed on Mt. Diablo. A cavity and 9 dB collinear antenna could be used by either repeater. Although the primary 146.19/.79 repeater was designed to run on battery power throughout the race, a portable 5 kW generator was used to power the 100-Watt simplex VHF transceiver, HF SSB transceiver, and the backup repeater. All of this equipment was transported more than sixty miles each way from the highway to be installed at the 9400-foot level of the 10,126-foot mountain, the highest in Baja.

Many of the checkpoints are inaccessible except by 4-wheel drive vehicles. The radio team for checkpoint 3 spent the night before the race in a Jeep trying to reach the assigned location, only 10 miles from a major highway.

For those who like to be close to nature, Baja offers many attractions. The mobile unit at Nuevo Junction reported seeing two rattlesnakes within the first thirty minutes.

All stations had checked in on site by 8:00 pm on Thursday, except for checkpoint 3, whose staffers reported that they were still underway despite deep sand conditions.

The VHF link repeaters installed on the mountaintops around Ensenada operated on 147.39/146.19 and 146.79/147.99. This allowed VHF units using 147.39/.99 in Ensenada to tie directly into the primary 146.19/.79 repeater atop Mount Diablo.

The race began at dawn Friday. Checkpoint 1 reported the first motorcycles an hour later and the first 4-wheel vehicles fifty minutes after that. Interest at race headquarters rose perceptibly with each passing moment — "Who's in the lead?" "Who's behind him?" Answers to these questions began to pour from the SCORE computers.

El Rodeo, checkpoint 6.

Operators along the network were busy copying passing times and stuck stubs. This constant activity continues all day and throughout the night. Questions were being asked — "Where is 321?" "Out of race at Nuevo Junction." "Driver OK." Concerned parties were kept informed via radio throughout the race.

At 11:30 am, a mobile unit reports an accident in the mountains. Paramedics are dispatched. Angel 1, an aircraft mobile unit, is contacted and heads for the area. Routine traffic continues to flow over the network. Reports come into Ensenada advising them of the driver's condition. Another mobile unit is directed to pick up a doctor at Valle de Trinidad and rendezvous with the rescue team on the highway near checkpoint 6. Angel 1 contacts the crew at checkpoint 6 to obtain information on the possibility of landing. Ensenada approves and Angel 1 lands at El Rodeo.

Another accident occurs at El Rodeo, so Angel 1 is told to leave with this injured driver while the paramedic team continues on the highway to Ensenada. Medical authorities are able to make efficient decisions with up-to-the-minute information available through the BARRA network.

During the hot afternoon, a helicopter is dispatched in answer to a paramedic team's request to transport an injured driver in the eastern desert.

An amateur operator in Vista, California, keeps emergency facilities in San Diego informed of rescue activities. Because of his efforts, everything is ready when injured drivers arrive later in San Diego.

Ensenada Control authorizes closing checkpoint 1. The radio team leaves to become a mobile team at Ojos Negros to provide communications in case of trouble where the course crosses the main highway from Ensenada to San Felipe.

At nightfall, another paramedic team is dispatched to a remote area. The team requests that an ambulance meet them at the highway when they come out, and an efficient effective transfer is accomplished.

The use of amateur-radio-equipped mobile units and aircraft in the communications plan made it possible to communicate from Ensenada Control to rescue units at the scene for the first time in Baja off-road racing. This contributed greatly to driver safety. SCORE regulations are very strict concerning safety rules, and BARRA is proud to play its part with efficient communications.

Toward the end of the race, when most of the cars are past the finish line, the "sweepers" began their lonely trek from one checkpoint to the next to report abandoned vehicles along the course and pick up any lonely drivers who may be discovered along the way. Many of the sweepers are radio teams on their way back to the highway after the last racer has passed. The radio voices in the night are reassuring to the tired hams as they make their way down the rough worn course and on to Ensenada or Mexicali.

Relatives and friends receive reassuring news about drivers and learn where a few unreported race cars are located. By dawn, only a few stragglers are still on the course. The pit crews and spectators have gone. The tired radio operators dismantle their antennas, pack their equipment, and head back to their home QTHs. They are already thinking of the next Baja race, planning new and better methods for next time, and carrying with them a sense of pride in a job well done. ■

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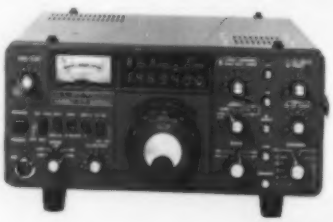

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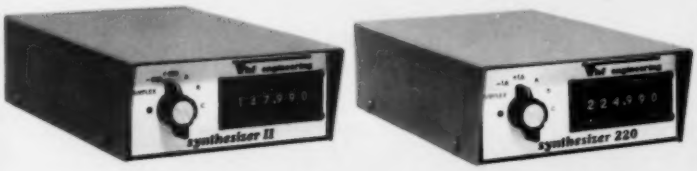

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- Complete kit including all electronics, crystal, thumb wheel switch, cabinet, etc.

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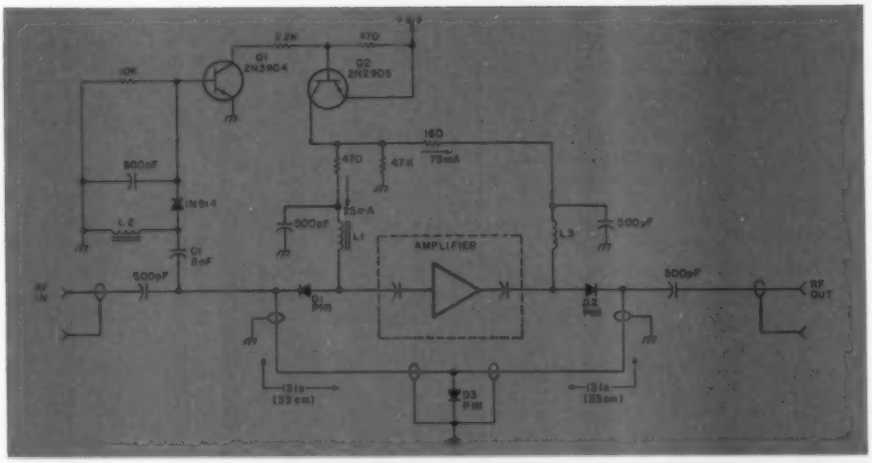


Fig. 1. PIN diode rf switching.

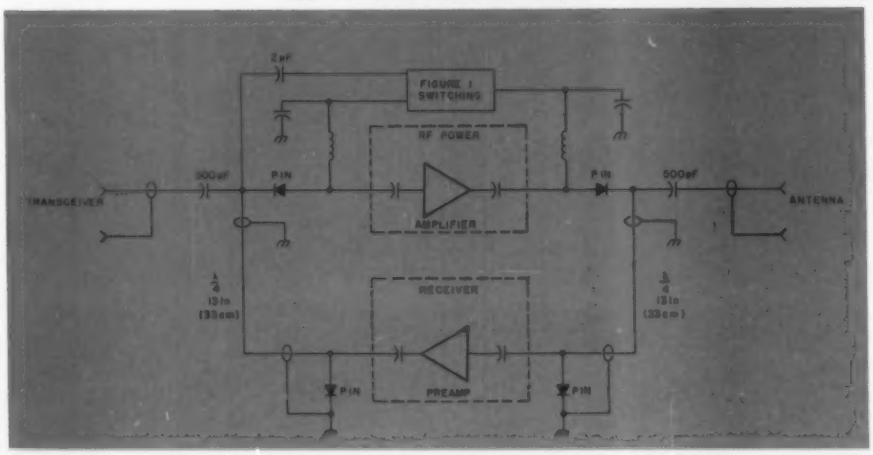


Fig. 2. Power amplifier and preamplifier switching scheme.

I always thought that exotic parts like PIN diodes were not for ordinary folks like hams—we should just stick to the "meat and potatoes" and leave the space-age components to the scientists. It was only after I learned the law of this part (how it works) that I discovered a really neat application.

How It Works

Its name describes its construction: P stands for P-type semiconductor, N stands for N-type semiconductor, and I stands for intrinsic (no P or N doping). If you put a forward bias on the diode, it will conduct. Back biasing the diode will result in no (very little) current flow. That's just like a conventional diode, right? What is happening is that, in the forward bias case, there are excess (free) electrons in the intrinsic region. Moreover, the electrons will remain in this region for a few microseconds after the bias is removed. The time is called the "majority carrier lifetime" and is a property that can be put to use. The reverse bias

properties that are useful are a high resistance and an extremely low capacitance, typically tenths of picofarads. At zero bias, the capacitance is only 1 or 2 picofarads.

This diode can pass Amperes of rf power with only a few millamperes of dc bias. The secret is in the long "lifetime" property. If the period (1/f) of the rf is shorter than the lifetime, then, during the time the rf voltage is reversed, there will be enough electrons in the intrinsic region to allow conduction.

Application

The circuit in Fig. 1 shows how I used three of these diodes to switch a two-stage two meter amplifier. You can see from the photograph that the circuit board was made by the cut-and-peel method. Locate the quarter-wave lines, and you will find the diodes at the ends. This amplifier is used with 2 Watts input and 45 Watts out and is utilized to boost my hand-held portable while in the car.

The two quarter-wave transmission lines are made with RG-188; you could use any of several kinds of small 50-Ohm cable. The small capacitor is a gimmick made of 20-gauge insulated wire, twisted for 3/4" (2 cm). This capacitor couples a small amount of rf, which is detected, filtered, and used to turn on the NPN switching transistor, Q1. This then turns on Q2 (a PNP switching transistor).

The 100 milliamperes of collector current divides, with 25 milliamperes through D1 and the other 75 milliamperes through D2. The current recombines in D3. This small amount of dc is enough to pass 45 Watts! The low impedance of D1 couples the input power to the amplifier. The low impedance of D3 is reflected as a high impedance at both the input and output. During receive, the diodes are zero biased and have a capacitance of only one picofarad or so. The receive signal, therefore, takes the bypass route through the quarter-wave sections, as the diodes now present a high impedance.

Preamp Switching

The circuit in Fig. 2 is offered as a suggestion for those who enjoy adventure. This one will give a boost both going and coming.

I just don't have the nerve to put a sensitive, delicate receiver preamp in the same box with that brute. I have not tried this, so don't blame me if rf eats your preamp up! Seriously, though, it ought to work just fine.

Up Your Coax

Why not supply the required 12 volts via the coax and put the amplifier/preamp right at your antenna? It won't do much for transmit, but it should give you an advantage over the coax loss for receive. Use chokes to isolate the dc from the rf, as shown in Fig. 3.

Diode Source

The first diodes I tried were expensive microwave types that were discarded from a test-and-evaluation program. Exotic parts like this rarely find their way into the surplus market, so, after I decided to write this article, I began to look for an inexpensive dependable diode source. Unitrode has such a diode—part number UM4001B.

I will gladly correspond about this and other articles I have written if you will send an SASE. ■

Reference

James K. Boomer W9KHC, "Pin Diode Transmit/Receive Switch for 80-10 Meters," *Ham Radio*, May, 1976.

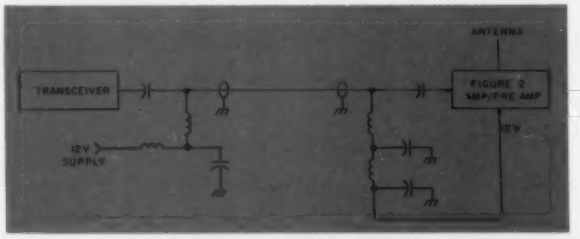
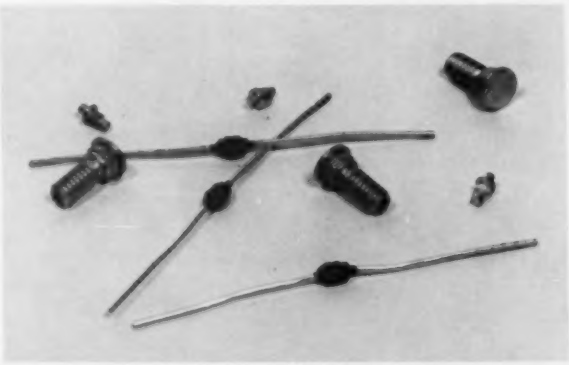
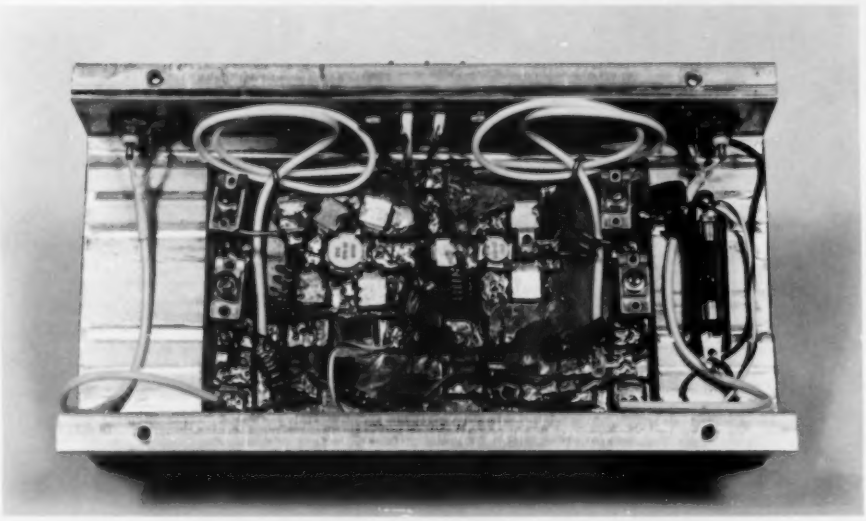


Fig. 3. Send 12 volts up your coax to supply the amp/preamp located near the antenna.



PIN diodes come in many shapes.



A two meter amplifier with PIN diode switching.

The Autodialer Revisited

—a circuit board and other improvements

William Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

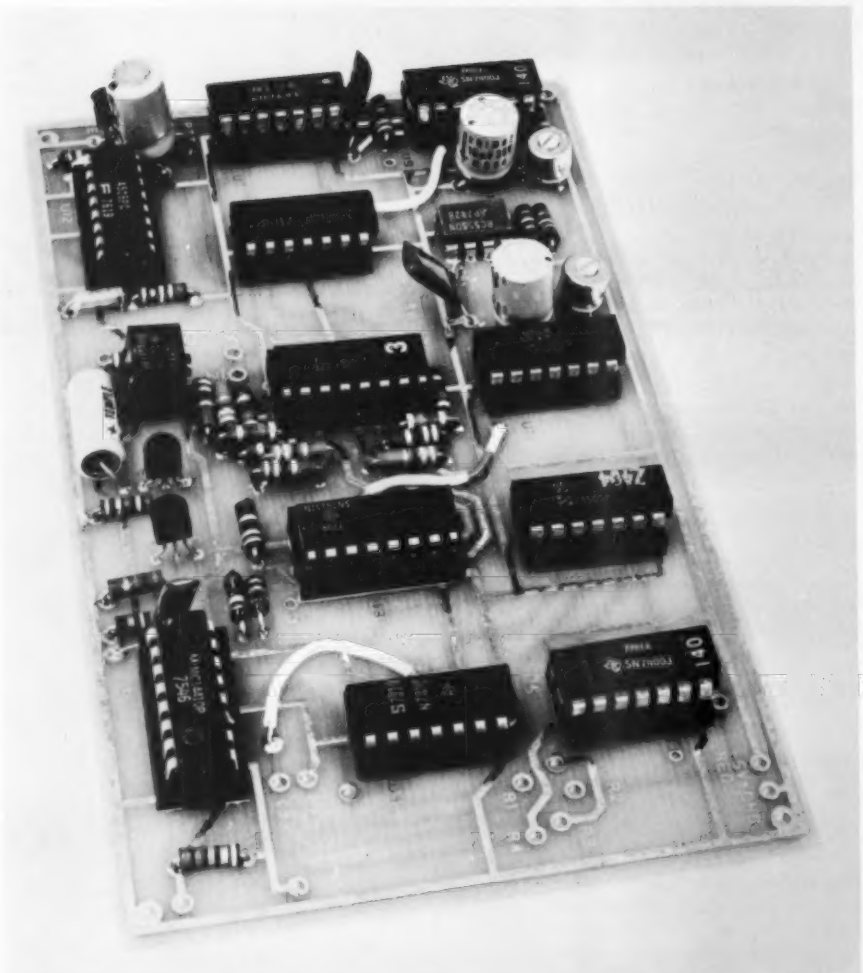


Photo A. This is a photograph of the completed autodialer printed wiring board. The memory (center) should always be in a socket.

It often happens that six months to a year elapses between the time an article is purchased and the time it is out in print. Also, it may take a couple of months to put an article together. Therefore, it may be as much as two years between the time an article gets designed and the time it gets into print. For various reasons, my autodialer (*73*, February, 1977) took almost 2½ years, and, in that time, several things came about which I felt might be of interest to you.

The first thing that happened was that there was

Fig. 1. Partial schematic of the autodialer. S1 is the added SPST switch in order to use an external pad.

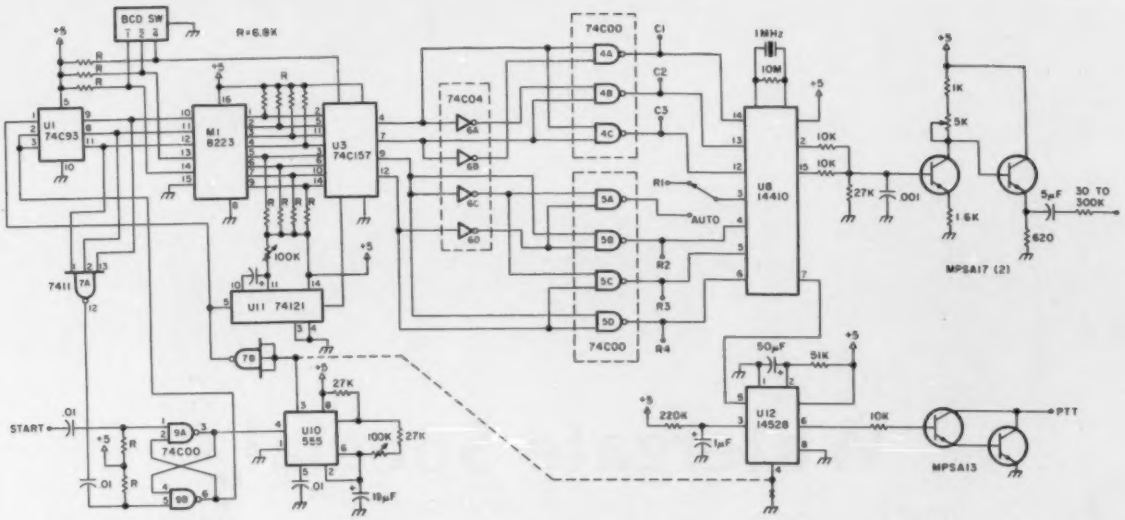


Fig. 2. Complete schematic of the dialer. All resistors marked R are 6.8k, ¼-Watt, 10%. A printed wiring board is available from W7JSW.

sufficient local interest from my friends that I developed a board for it. The circuit was moderately complex and a board made the thing a whole lot easier to put together. Photo A shows the completed circuit board. The boards are available from me for $13.50 ppd.

Circuit Changes

One problem came to light very early with the eight-number version of the dialer. The necessity to encode two memory lines to four row select lines left no unused code. This means that the R1 line is active all the time the device is idle. The way the device (14410) works, this presents no direct problem since no tone will be sent until both a row and column are energized. What it did do was make it impossible to use an external pad switch with the dialer. Addition of an SPST switch took care of this problem with little effort or expense. The change is shown in Fig. 1.

I had a couple of complaints about the power consumption which I largely ignored, not wishing to either lay out the printed wiring board again or redesign the circuit (I'm kind of lazy). Another obstacle to redesigning the circuit was the absence of an eight-bit, low-power, field-programmable read-only memory. Well, in the couple of years since the circuit's inception, a line of pin-compatible TTL to CMOS devices was introduced in the 74Cxx line. In this line, a 74C00 is a pin-for-pin replacement for a 7400, only CMOS instead of TTL.

I looked the old circuit over carefully for circuit loading and device types and came up with seven TTL devices that can be replaced with CMOS substitutes. Table 1 shows the devices replaced and shows that they should save about 100 to 150 milliamps. If you are just building up the circuit, you can change the 4.7k pull-up resistors to 6.8k with no degradation of circuit performance.

A couple of people have told me that the transistor PTT switch will not pull their PTT line low enough to properly key the transmitter. In this case, I recommend driving a low-power relay with the output switch and then use the relay contacts to key the radio.

Depending on how fast you run the dialer and how slow your transmitter comes up, you can lose anywhere from half to all of the first digit tones. One remedy for this is shown in Fig. 3. With this connection, the PTT switch operates off the clock and therefore comes up earlier. This connection is shown as a dotted line in the schematic of Fig. 2.

DEVICE	CURRENT	DEVICE	CURRENT
7400	20	74C00	2
7400	20	74C00	2
7400	20	74C00	2
7404	30	74C04	2
7493	26	74C93	4
74157	30	74C157	4
TOTAL:	146	TOTAL:	16

Table 1.

By way of alternate (or devious) assembly methods, a local ham concocted a small version of the dialer using wire-wrap techniques instead of printed circuit board. He could not find real small thumbwheel or other BCD coded switches so he used miniature toggle switches coupled with a BCD to 7-segment decoder and LED to give a readout of the selected phone number.

Conclusion

The board turned out quite well, and the change to CMOS has cut the current consumption way down. As time goes on, I'm sure I'll come up with more changes or modifications.

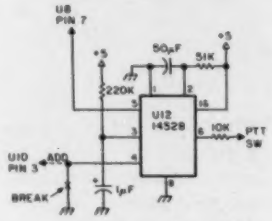


Fig. 3. Circuit modification to allow the output switch to start with the clock.

If any of you have come up with something neat using this or any of my circuits (for example, using the dialer with a microcomputer), I'd love to hear about it. If you write and want a speedy reply, though, please include an SASE. For those who might not have the February, 1977, issue of *73* handy (heaven forbid), I have included the complete schematic of the dialer as Fig. 2. ■

Watergate Special

— create your own 18-minute gap

Toni Ruepp HB9BLU
Landstrasse 169
CH5422 Ob. Ehrendingen
Switzerland

There are a lot of little things you could build and make use of. You only have to grab around in the junk box and then develop ideas. One such item is the following. It doesn't cost you one cent, but it can be very useful.

There are many reasons why you might want to erase a tape before rerecording on it. Also, you may have to erase a recording very quickly. This could be a help for secretaries who want to erase a dictation after the letter is written, or for members of the government after they've been elected . . .

The construction is very easy. All you need is an old final transformer (tube-type, with an impedance of about 7k Ohms), a bell switch (isolated, good for your line voltage), and a plastic box.

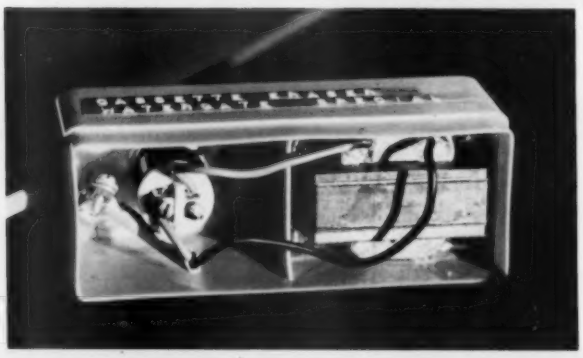
The transformer must have an E/I-shaped core. Remove the I part of the core, cut the secondary wires (heavy wires), and put the transformer into that plastic box. Wire it according to Fig. 1, and glue it with epoxy. Then seal the box, so nobody can get an electrical shock.

Here's how to use it:

1. Put the cassette on top of the (hidden) transformer.
2. Push the button and move the cassette around in the magnetic field for about 3 to 8 seconds.
3. Remove the cassette and then release the button.

Do not exceed 10 seconds, as the coil might get too warm, especially when using 220 V.

The Watergate special.



Bottom view.

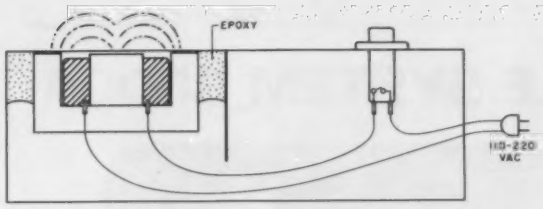


Fig. 1.

This way of demagnetizing tapes works very well, and the disadvantages of other ways do not exist. There is less noise on the tape, and there are no magnetic springs in the cassettes.■

How to use it.

New Products

from page 24

package requires only 12 Watts or less at 117 V ac, 60 Hz. A 220 V ac 50/60 Hz version is also available at a 10% additional cost.

The DM-1 is one of four instruments in CSC's Design Mate series. For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.*

HEATH 100 MHZ TO 1 GHZ BIDIRECTIONAL WATTMETER

Using Heath's new Bidirectional RF Wattmeter Model IM-4190, I've been able to tune up my 2 meter rig and antenna system so that it's working more efficiently and effectively than ever before. Now I'm looking forward to using it to get a 70 cm mode J setup going so I can join the activity taking place via OSCAR 8.

A simple, easy-to-assemble one evening project, the RF Wattmeter measures rf output up to 300 Watts within the frequency range of 100 MHz to 1 GHz. There are three switchable ranges for forward power (30, 75, and 300 Watts) and three for reflected power (3, 7.5, and 30 Watts.) The 3-Watt range is read on the 30-Watt scale. Power is read directly in Watts in both forward and reflected positions. Swr may be readily determined by referring to the graphs on page 11 of the illustration booklet that accompanies the kit, or by using the formula on page 33 of the assembly and operating manual.

Housed in a small, attractive blue and white cabinet, the RF Wattmeter is an easy-to-use, self-contained unit that does not require additional plug-in "slugs" or modules to cover its power and frequency ranges. Power is obtained from a 9-volt transistor radio battery (NEDA #1604). The Wattmeter's portability is enhanced by a large D-ring handle on the rear of the cabinet that can be snapped onto a belt hook, making it convenient to use on towers and in other situations where both hands must be used for climbing or making adjustments.

Assembly of the Model IM-4190 RF Wattmeter makes a nice evening's project. Everything goes together in a smooth and trouble-free fashion. Initial test and adjustment may be done in a couple of minutes using a small screwdriver. Calibration requires more time and equipment. To accurately calibrate the RF Wattmeter, you will need a signal generator capable of producing a signal in the 400-MHz range with a variable power output from 3 to 300 Watts, a power meter capable of measuring the frequencies and power levels previously mentioned, and an rf load which presents an swr of 1.1:1 or better. The accuracy of the RF Wattmeter will, of course, depend upon the accuracy of the calibration instruments.

Calibration of my own Wattmeter produced the following readings:

Forward

30-Watt range = 30 Watts
15-Watt range = 15.5 Watts
75-Watt range = 75 Watts
300-Watt range = 302 Watts

Reflected

30-Watt range = 30 Watts
7.5-Watt range = 7.6 Watts
3-Watt range = 3 Watts

The RF Wattmeter may be permanently connected between the output of the transmitting equipment and the transmission line to provide an accurate means of determining the swr in the transmission line and terminating load, and as an aid in tuning the equipment for optimum output. Cables with either Type N or UHF (50-Ohm) male connectors may be used with the Wattmeter (do *not* use UHF connectors and UG-146/U coax adapters for frequencies above 300 MHz). By the way, Heath thoughtfully includes a pair of UG-146/U Type N to UHF adapters with the kit.

The Wattmeter may be used with any matched transmission line without affecting equipment performance. If, however, there is a mismatch in the line, prepare a four-inch length of cable with connectors to replace the length of line lost when removing the unit from the line. Before using the Wattmeter, always turn the function switch to the BATTERY CHECK position and observe if the pointer falls within the BATT OK range of the meter scale. If the battery does not check OK, replace it before proceeding.

For use in the forward or normal mode of operation, your transmitting equipment should be connected to the input of the Model IM-4190 RF Wattmeter and the antenna or dummy load to the load connector. However, the RF Wattmeter is *bidirectional*, enabling you to connect equipment with limited output in the reverse or reflected direction. A couple of typical examples of use for the Wattmeter in the reverse mode would be determining if an extreme mismatch exists in the transmission line or at the load, or, using it as a peaking indicator to adjust your equipment in the same way as when the unit is connected in the normal (forward) mode.

With the RF Wattmeter connected in the reverse mode, it becomes an excellent tuning aid when tweaking a low-power rig for optimum power output, particularly when set to the 3-Watt range, since the reflected power scales actually show forward power. Of course you seldom get something for nothing, and when using the RF Wattmeter in the reverse mode, the reflected readings taken from the forward ranges are of such negligible values as to be of little use in determining swr.

An important feature of the Wattmeter is that it is capable of withstanding full-power overloads on its lower scales without damage to the meter movement.

The Bidirectional RF Wattmeter Model IM-4190 kit retails for $114.95 and an assembled version, the SM-4190, is $195.00 (mail order from Benton Harbor). *Heath Company, Benton Harbor MI 49022.*

Morgan W. Godwin W4WFL
Peterborough NH

10 METER CB

American Crystal Supply Company's Engineering Department has put together approximately 55 different 10 meter kits which convert relatively inexpensive SSB CB rigs to cover any part, or all, of the 10 meter band. Kits are available for the Novice segment only, or phone band only, or both.

The builder can request an order form and pick the kit that will best suit his needs, or he can send them the make and model number of his radio. They will then send him the appropriate kit, if available. If not, they will make a kit especially for him.

The prices range from $10.00 for the Novice band only, to $40.00 for the super-deluxe full-band kit on certain radios, depending on the parts required for his radio. Prices vary, but most will run under $20.00 for full 10 meter coverage.

Continued on page 42

THE INCOMPARABLE SYSTEM 3000A

HAS A BUILT-IN $450 DISCOUNT

$450 discount? When you buy SYSTEM 3000A, you're getting $1000+ worth of unequaled performance for $549. Examine the unique features of SYSTEM 3000A, add up what it would cost to duplicate (if you could) this small, feature-filled radio and you will quickly realize what a remarkable bargain you're getting. By marrying the best transceiver available to a microcomputer-controlled PLL synthesizer, **Edgecom** has produced a 2-meter FM system with such unique and incomparable operating flexibility it is almost unbelievable. A few of the extraordinary features of SYSTEM 3000A found in no other transceiver are:

- **TWENTY FRONT-PANEL-PROGRAMMABLE CHANNELS.** *Just dial in the frequency and transmitter offset, press the Enter switch and you're in memory. Two channels are instantly recallable as priority channels at the flip of a switch.*
- **TWO BUILT-IN SCANNERS** *with adjustable pause and pause-defeat features. One scanner lets you tune the band in one or four MHz segments. The other scans the memory.*
- **MEMORY-CHANNEL MONITOR.** *Lets you operate on one frequency while monitoring one or more others.*
- **ANY TRANSMITTER OFFSET.** *In addition to the standard ± 600 kHz you can program any offset from 5 kHz to 4 MHz.*
- **FULL TWO-YEAR WARRANTY.** *Every SYSTEM 3000A is warranted to be free of defects for two years. And it is American made so servicing is no problem.*

Combine these, and the other unique operating features of SYSTEM 3000A with a receiver of unsurpassed selectivity and intermod performance, a transmitter that produces over 25 watts of (adjustable) power and you have a fantastic $1000+ transceiver for the remarkable price of $549.

SYSTEM 3000A . . . PERFORMANCE THAT CHALLENGES YOUR IMAGINATION
See one at selected dealers or write for more information.

Edgecom Inc.

2909 Oregon Ct.—A3 • Torrance CA 90503 • (213) 533-0433

EXPORT INQUIRIES H & H Industries • Box 639 • Redondo Beach CA 90277 E19

NOW FROM EDGECOM . . .
ANOTHER INCREDIBLE BARGAIN

THE FMS-25 . . . ONLY $439

For the discriminating amateur desiring the maximum operating flexibility at the lowest possible price, **EDGECOM** proudly presents the **FMS-25** 2-meter FM transceiver. Featuring the same receiver/transmitter and several of the outstanding features that have made the **EDGECOM SYSTEM 3000A** the industry standard, the **FMS-25** provides superior performance for the same price you would normally pay for a "bare-bones" radio. Compare the fantastic features of the **FMS-25** with the other transceivers on the market and you will quickly conclude that there is no question of which one offers the most for the least amount. Some of the many features of the **FMS-25** are:

- **BUILT-IN SCANNER**
- **TEN FRONT-PANEL-PROGRAMMABLE MEMORY CHANNELS**
- **ANY TRANSMITTER OFFSET**
- **ELECTRONIC PUSH-BUTTON TUNING**
- **25 WATTS OUTPUT**
- **SUPERIOR INTERMODULATION PERFORMANCE**

Like the **SYSTEM 3000A,** the **FMS-25** also enjoys a full two-year warranty, it's American made and it is small (the photo above is full size). The **FMS-25** . . . at the unbelievable price of $439 you're getting the best transceiver available with free scanner, a free amplifier, and a free ten channel memory. See the fantastic **FMS-25** at selected dealers or write for a descriptive brochure.

FMS-25 . . . PERFORMANCE THAT CHALLENGES YOUR IMAGINATION

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Be Legal

—build an ID reminder

Ronald Miles AD4A/WA4MFY
RFD 1, Box 216
Rustburg VA 24588

Although several designs for highly accurate ID reminders have appeared recently in amateur radio publications, they have generally fallen into one of two categories. Either they are intended for use with specific digital clock circuits, or they have been designed as units in themselves, having digital readouts or various other options. Many operators, though, may have already purchased one of the inexpensive clock kits on the market today. They make excellent station timepieces and, with the addition of the circuit below, may also be used as precision ID reminders.

In addition, since the circuit is complete in itself, normally requiring only power and a line-frequency input from the unit to which it is added, it may be used in various other ways. For example, one might add it to an existing transmitter or receiver so that the digital dial or pilot lamp would begin to flash when it's time to identify. Its usefulness is further enhanced by the fact that it may be preprogrammed for various delays, and it can be made to operate with a line frequency of fifty, as well as sixty, Hertz. Also, supply voltage requirements are not at all critical, as anything between six and fourteen volts will suffice. The cost of the unit is minimal. The basic timer can be built for approximately six dollars. If the optional power supply and indicator circuit are also used, the cost will run a few dollars more.

The circuit is shown in Fig. 1. Here a 110-volt power supply has been added, as well as IC5, which is used to drive an indicator circuit. If the unit is to derive its power from existing equipment, components T1, D5-D8, and R8 may be eliminated. In addition, C2 may be reduced in value and, in some cases, deleted. If the circuit is to drive a high-impedance load, such as the enable of a clock chip, IC5 and its associated circuitry may also be eliminated. As shown, the 60 Hz (or 50 Hz) waveform is injected at point "A". For reliable operation, it should have a peak amplitude anywhere between V_{dd} and $2V_{dd}$. Thus, if the supply voltage used was 10 volts, the peak value of the input waveform could be anywhere between 10 and 20 volts. This will always be the case if the input is derived directly from the transformer, as shown, but, if other means are contemplated, the above should be taken into consideration. The signal passes through D1, which eliminates the negative half cycle, to the low-pass filter consisting of R2 and C1. It then enters a Schmitt trigger consisting of IC4A, IC4B, R3, and R4. The low-pass filter and the hysteresis of the Schmitt combine to make the circuit insensitive to any rf or noise present on the input waveform. The high gain of the circuit produces a square wave at pin 9 of IC4B which will adequately drive the clock input of IC1, a 4020 binary ripple counter. By tying various output combinations from the counter to AND gate IC2, various timing intervals may be selected. That of the circuit hereafter

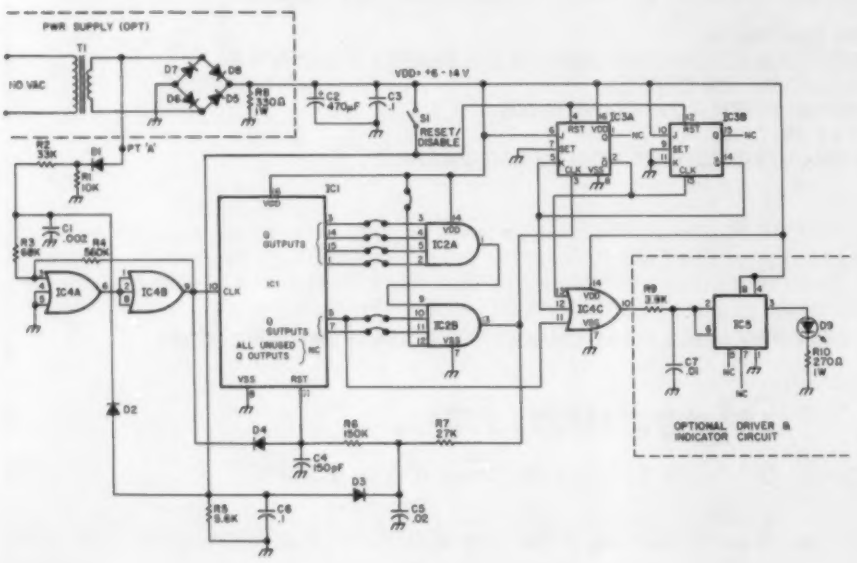


Fig. 1.

described will be 9 minutes, 50 seconds at 60 Hz line frequency. Circuit operation for other intervals is completely analogous. I'll say more on this later. IC1 counts the pulses at its input until output pins 3, 14, 15, 1, 5, and 7 are simultaneously high. This will first occur exactly 3 minutes, 16-2/3 seconds after the timer is activated, or after exactly one third of the required 9-minute, fifty-second timing period.

The high output of IC2B is fed to IC3A and to a circuit consisting of R7, R6, C5, C4, and D4, whose purpose is to reset IC1. It does so in the following manner: IC1 toggles on the negative-going edge of its clock input. Assume that the final 60 Hz pulse just before the completion of the 3-minute, 16-2/3-second interval is occurring. As the clock input at pin 10 of IC1 is going low, the inputs of IC2 go high. This causes the output of IC2B to go high. When this occurs, capacitor C5 begins to charge up through R7. Since the level at pin 10 of IC1 has gone low, however, reset pin 11 is also held low by D4 during this period, so the counter cannot yet reset. Finally, after C5 is fully charged, the input at pin 10 again goes high. This allows the voltage on C5 to be transferred through R6 to pin 11, thereby resetting the counter. When it does reset, pin 13 of IC2B is again driven low. C5 then discharges back through R7, thus completing the process and allowing the counter to count again. IC3 is a dual J-K flip-flop, connected to act as a divide-by-three counter. After 9 minutes, 50 seconds, when the above process has occurred three times, pin 2 of IC3A and pin 14 of IC3B will both be low. The highs on pins 12 and 13 of OR gate IC4C are thus removed, and it responds to the 1.875 Hz input present on pin 11. Therefore, after the preset time has elapsed, a 1.875 Hz square wave will be present at pin 10 of IC4C. This point can often be connected directly to the enable of the clock chip, since the current requirements of such are small, and R9, C7, IC5, and the indicator circuit are eliminated. IC5 is a 555 timer, used as a buffer-driver in this case to increase the drive capability of the preceding CMOS circuitry. Pin 3 can source or sink about 150 mA when the supply voltage is 10 volts. The output circuit consists of an LED indicator and current-limiting resistor, though many other possibilities exist, of course. R9 and C7 serve an unusual purpose. It was originally desired to drive pins 2 and 6 of IC5 directly from pin 10 of IC4C. The moderately fast rise time of the waveform at this point, however, tended to cause erratic operation of the 555. This is not surprising, since IC5 was designed for use as a timer, not as a buffer driver. R9 and C7 were then added to increase the rise time of the input at pins 2 and 6, after which no further problems were encountered.

All operating functions are controlled by switch S1. When the unit is not in use, S1 should be left closed. This applies a high through D3 and R6 to reset pin 11 of IC1, and a second directly to the reset terminals of IC3A and IC3B. A high level is also applied through D2 to the junction of R2 and R3. This disables the Schmitt trigger and holds output pin 9 of IC4B high. A high is required at this point during the reset process. Otherwise, diode D4 would clamp pin 11 of IC1 to ground and prevent the counter's resetting. The timing cycle is begun when S1 is opened, and the timer can be reset at any time by simply closing S1 and immediately opening it again.

As may be gathered, installation is normally not difficult. In general, you only need to connect the circuit across the clock-chip power supply, connect its output to the clock enable, and tie the 60 Hz input to a suitable point. Still, in a few cases, this might not be feasible. Perhaps the correct supply voltage is not available, or maybe you desire to control a frequency display instead of a clock. In that case, you might build the circuit of Fig. 1 in its entirety, including both the optional power supply and IC5. It is normally no problem to replace the indicator circuit shown with a simple interface circuit suitable for the occasion. Often a single transistor will suffice. Regardless of the installation employed, however, you should take note of the following: When IC4 is a 4075 OR gate, as shown, output pin 10 will be high during the counting period (and when the timer is disabled) and alternate at its conclusion. The high level occurs because, at that time, there is also a high present at its input — either on pin 12, pin 13, or both. Since a high is required on the enable of most clock chips to activate the display, this means that it will be visible during the counting period and flash at its conclusion, as desired. Should it be observed in any installation that the display is being blanked during the counting period, the enable logic for that particular situation is reversed. In that case, you should replace IC4 with a 4025 NOR gate (a pin-for-pin replacement) to correct the difficulty. When IC5 is employed, it acts as a voltage inverter, so the above process would be reversed. In general, then, using one type of IC4 will cause the display (or other indicator) to be blanked during the counting period, while using the other will cause it to be visible. The choice will depend on the type of indicator circuit chosen, as well as the preference of the builder.

Time interval	Line frequency	Pins IC1 used
10 min., 0 sec.	60 Hz	1, 3, 4, 6, 13, 14, 15
9 min., 50 sec.	60 Hz	1, 3, 5, 7, 14, 15
5 min., 0 sec.	60 Hz	2, 4, 5, 6, 12, 14, 15
10 min., 0 sec.	50 Hz	3, 5, 12, 14, 15
9 min., 49.98 sec.	50 Hz	3, 4, 6, 7, 9, 14, 15
5 min., 0 sec.	50 Hz	2, 7, 12, 13, 14

Table 1.

I stated at the beginning that this circuit is programmable. A brief explanation is now in order as to how this is accomplished. I will, therefore, demonstrate how the connections between IC1 and IC2 for the circuit previously described, i.e., the 9-minute, 50-second 60 Hz version, were determined. Those for other timing intervals can be obtained in a similar manner.

This circuit is basically a counter. Therefore, you must determine how many 60 Hz pulses will occur in a 9-minute, 50-second or 590-second period. 590 sec. x 60 pulses/sec. = 35,400 pulses. IC1 only counts up to one third of the required number before it is reset, however. It therefore resets after 35,400 ÷ 3 = 11,800 pulses. IC1 is a true binary counter, so the 11,800 figure must be converted to binary. It is equal to

Parts List

All resistors	½ Watt, 10% tol., except as noted
All capacitors	25 V or greater breakdown voltage
D1-D4	Silicon diode, 1N914 or equivalent
D5-D8	Silicon rectifier, 1 A at 50 V piv
D9	50 mA LED (Radio Shack 276-026 or equivalent)
IC1	4020 binary ripple counter
IC2	4082 dual 4-input AND gate
IC3	4027 dual J-K flip-flop
IC4	4075 triple 3-input OR gate, or 4025 triple 3-input NOR gate (see text)
IC5	555 timer
T1	110/9 V power transformer
S1	SPST switch

10111000011000. Now, starting at the right-hand side of the number, count left until the first "1" is found. It will be four digits from the right. The second will be five digits, the third ten digits, the others eleven, twelve, and fourteen digits. The corresponding Q outputs of IC1 must be tied to IC2. Thus, tying Q4, Q5, Q10, Q11, Q12, and Q14 to the various inputs of IC2 will produce a 9-minute, 50-second counting period. These outputs correspond to pins 7, 5, 14, 15, 1, and 3 of IC1. For this particular delay, I needed only six of the AND gate inputs. The unused input was tied to V_{dd}. From the above, it can be seen that many counting intervals are possible with this circuit, but not all. For example, if the binary number for a particular interval had ten "ones" in it, there would not be enough AND gate inputs to handle them. Nevertheless, a great many are possible. Even when exact intervals may not be had, they may generally be approximated very closely. Table 1 shows the connections for some of the more popular ones, each of which was determined by using the procedure above. All unused inputs of IC2 should be tied to V_{dd}. In one case, an exact interval could not be had, so the table shows that of the nearest approximation.

Lastly, remember that the above circuit consists primarily of CMOS ICs, which are much more easily damaged by improper handling and installation than TTL. I therefore heartily recommend that you review the operation of CMOS circuitry in general before building the circuit above – especially if you are considering adding it on to some existing circuit. It could, in the long run, save time and expense. ■

New Products

from page 37

Some of the PLL radios will include the M-20 Kit to get the radio out of 27 MHz.

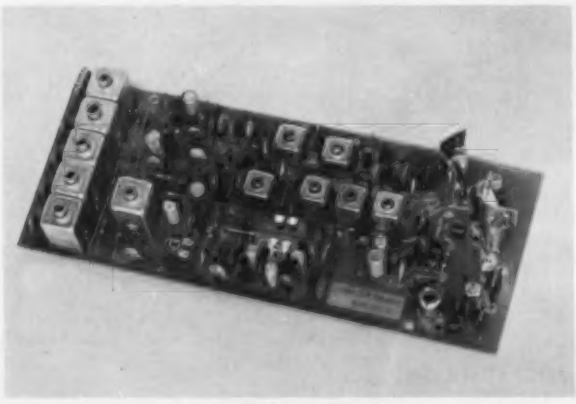
The instructions are very simple to follow and are explained in a step-by-step procedure or installation of these kits can be performed at the factory for those desiring such a service. Write for specific prices and include the make and model number of the CB you wish to have converted. Contact *American Crystal Supply Co., PO Box 638, West Yarmouth MA 02673; (617)-771-4634.*

HAMTRONICS' NEW VHF EXCITERS AND POWER AMPLIFIERS

Hamtronics, Inc., has a new series of FM transmitters for the 6 meter, 2 meter, and 220-MHz amateur bands. The new model T50 exciter module is constructed on a 3" x 7½" PC board. It features 2 Watts rf output, good clear audio, built-in test points for easy alignment, and six channels. The price for this FM exciter kit is only $49.95.

As a companion for the new T50 exciter and Hamtronics' XV2 series of VHF SSB transmitting converters, a new line of VHF linear/class C power amplifiers has been released. The model LPA 2-15 features 15 W SSB or 20 W FM/CW output with 2 W drive. The model LPA 2-45 provides 45 W output. These PA units and others are available for 6 meters, 2 meters, and 220 MHz as semi-kits, with the critical parts of assembly already done. The prices of the linear power amplifiers start at $59.95.

A free catalog is available on these and other VHF and UHF kits, preamps, receiving converters, FM receivers, and transmitting converters. For more information, contact *Hamtronics, Inc., 182-F Belmont Rd., Rochester NY 14612; (716)-663-9254.*



Hamtronics' 6 meter exciter.

PACE-TRAPS FLYING DUCKY

Two meter FM operators should find the new Pace-Traps Flying Ducky a handy and useful addition to their present setup. The Flying Ducky was designed to fill the performance gap experienced by most 2 meter mobile operators when using their HT in an automobile. Within the confines of the car body, the rubber ducky with which most HTs are equipped does only a marginal job at best. This generally limits communications to very nearby repeaters and mobile and fixed stations in the immediate vicinity.

The Pace-Traps Flying Ducky eliminates the handicap of operating from inside the car by providing the means for quickly and simply positioning and connecting an external antenna to the HT. The arrangement takes full advantage of the excellent ground plane provided by the vehicle's metal roof. No additional antenna is required as in the Pace-Traps system. The HT's rubber ducky itself becomes the outside radiator.

The device consists of the following: a chrome-plated magnetic mount which has a hold-down power of 50 pounds and which will stay securely in place at speeds well in excess of the 55 mph limit; a mount which is equipped with a connector that mates with that on the rubber ducky; a matched length of coax cable (105 inches) provided with a connector to fit the HT.

Installation takes ten or fifteen seconds. The rubber ducky antenna from the HT is inserted into the magnetic mount. The mount is placed in the center of the car roof and the cable is routed either through the door jamb or an open window. (The thick rubber weather stripping on most cars makes closing the door on the cable possible without damage.) Then connect the coax cable to the HT and you're all set.

Not the least advantage to using the Flying Ducky mount and your rubber ducky antenna as opposed to a fixed outside antenna is its low profile and the portability of the HT itself. When installed, it has a very low rip-off attraction and when removed, it has none!

While no lab-type test were performed, several on-the-air checks bore out the manufacturer's claims that the Flying Ducky's performance is better than a gutter-mounted quarter-wave and superior to a 5/8-wave mounted on the trunk deck.

The Flying Ducky ($13.95) can be used with your own antenna or with one of Pace-Traps' rubber duckys ($7.95). An accessory quarter-wave whip ($5.95) is also available. *Pace-Traps, Box 234, Middlebury CT 06762; (203)-758-9228.*

Morgan W. Godwin W4WFL
Peterborough NH

ALLIANCE INTRODUCES HD-73 HEAVY-DUTY ROTATOR

The HD-73 Heavy-Duty Rotator has been introduced by the Alliance Manufacturing Company.

Designed especially for the amateur who wishes to increase his capability with in-tower or mast-mounting option, the HD-73 features a unique dual-speed control with one five-position switch, providing a one minute-per-revolution speed for rotating over an extended arc, and slower speed control permitting fine adjustments.

The improved automatic brake action simplifies positioning and reduces risk of antenna damage by sudden stops.

Designed to operate antennas with a maximum of 10.7 square ft. of load capacity, mast-mounted, the HD-73 develops a wind-load bending moment of 10,000 in. lbs., capable of withstanding most

Continued on page 45

UNFORTUNATELY...

Radio equip-ment doesn't grow on trees!

You have worked hard for your money—don't gamble when you buy that next rig, antenna or even accessories. Contact C&A where they have been serving the amateur and commercial market for almost two decades. C&A can offer you the best prices plus the assurance that they will be there to back up your purchase with their staff of experienced **LICENSED** technicians and a genuine desire to add your name to their long list of satisfied customers.

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(213) 834-5868

5773 Overland
Boise, Idaho 83705
(208) 377-5274

Another IC-22S Scheme

— for oddball repeaters

R. B. Palmer WA1ZMQ
Box 3141
Lynnwood WA 98036

Worried about handling those odd 2m splits that still exist around this country and in Canada? Does the fact that Podunk, California, where you plan to vacation, has a repeater with input on 146.085 MHz have you down? Icom has done a good job, but, alas, there are more than 22 repeater combinations, as any traveler can testify. Here is a simple solution to enable your Icom 22S to send and receive on *any* frequency within the allocated two meter band and to enable you to work those repeaters with odd splits — those other than the standard 600 kHz for which the Icom and most other transceivers are precalibrated.

The solution is very simple. It involves no electronic components, no tedious Boolean logic or complex switching arrangements, and no modification of the interior of your Icom 22S. Essentially, either of two preprogrammed eight-pole dip switches are selected by a toggle. The dip switches are programmed in a straightforward manner, according to the Icom instruction manual, which offers the diode combination for attaining a given frequency. Dip switches are recommended, for their small size makes them compact for mobile use and enhances the ease with which they may be covered after programming — thus keeping them dust-free and eliminating the possibility of accidentally rearranging the switch combination in the dark while groping for the toggle.

The other parts needed are an eight-pole, double-throw toggle switch (two 4-pole slide switches may be substituted, with the handles connected to facilitate operation) and a suitable 9-conductor, color-coded cable to run the diode leads from your Icom to the external switch box. Any small package, such as a jewel or ring box, which is durable enough for mobile use, makes a compact case for your Icom All Frequency Selector.

Position 22 on the selector of the Icom was chosen, as the leads can be taken off from this end position more easily, without crowding them down onto other permanently programmed diodes, and, also, this "end-of-the-dial" position is easy to remember. The hot (when switched to position 22) lead is taken from the solder blob of the wire coming up to position 22 of the programming board within the Icom. All eight diodes are soldered into their banded end positions; the other leads of the diodes are cut one third of an inch long and bent over at right angles to the vertical diodes. Color-coded cable leads are soldered to these latter diode leads and the corresponding leads at the other end of the cable are soldered to the pins (in some numerical order) on the accessory socket at the back of your Icom 22S. The same

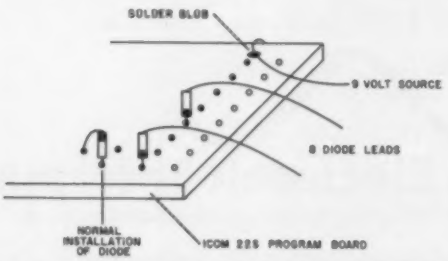


Fig. 1. All eight diodes are installed by the banded end in position 22. Eight wires lead from the diodes to the accessory socket. A ninth lead connects the 9 volt lead from the selector to the remaining position on the socket.

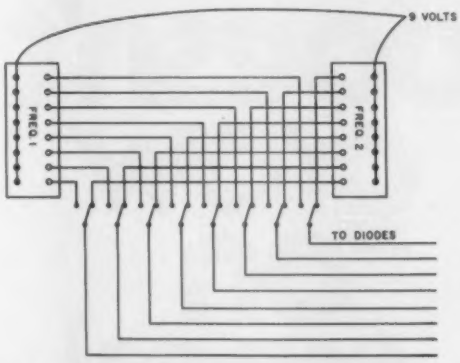


Fig. 2. Schematic for two dip switches and the 8-pole, double-throw toggle. A rotary switch or two 4-pole slide switches may be substituted for the toggle.

colored leads are soldered to the pins of the plug supplied with your Icom.

The umbilical cable, with the eight diode leads and the 9 volt hot lead, must enter the bottom of the back of the external switch box, and, from there, the leads are routed to the appropriate switch terminals or toggle terminals, accordingly. To facilitate simpler programming later on, it is advisable to position the switch banks to present a facade for the user of "down is off for all" and "up is on for all." In a field situation, with flashlight illumination and the random complexity of the Icom diode positioning instructions, it behooves the user to make his switching as visibly straightforward as possible. Similarly, wiring the leads to the switch terminals should follow the Icom frequency recipe; that is, viewed from the top by the user, the left-most switch should be connected to D7 inside your Icom 22S, the right-most to D0. Programming is then straightforward: Look up the frequency you want to use in the Icom list, turn off all switches, and turn on the switches for the proper diodes required by the Icom instructions.

Either switch bank may be used for transmit or receive by toggle selection. And so one switch bank may be set up for transmit for an odd split, the other set up for receive. Place your Icom in simplex mode (central position of right-hand toggle), throw your toggle to the "transmit" position, and transmit; let go of the mike button, throw your toggle to the "receive" position, and listen. That's all there is to it, and remember: Podunk, California, is no threat any more, nor are any of the other odd splits around the continent. ■

New Products

from page 42

prevailing wind conditions. Icing is overcome by a rotator torque of 400 in. lbs., made possible through the use of heavy steel, hardened pitch gear teeth. Consistent performance of the unit in all-weather conditions is enhanced with a lifetime, factory-installed lubricant that withstands temperature ranges of +120°F to −20°F.

Constructed of heavy-duty cast aluminum, and weighing only 9-1/8 lbs., with one set of brackets, the HD-73 rotator provides a vertical balanced weight capacity of 1,000 lbs., due to two full raceways of 100 3/8"-dia. hardened ball bearings. Unique support bracket design permits a centering procedure for in-tower application without shims or difficult trial-and-error adjustments. The base design permits easy four-bolt, in-tower mounting without spacers.

The HD-73's 20-volt ac, capacitor split-phase reversible motor and its transformer are protected by fuse and thermal protectors against shorts, possible connection error, or prolonged operation. No voltage on motor or leads exceeds U.L. safety limits.

The meter, a dc, taut band D'Arsonval, is calibrated in S-W-N-E-S as well as a degree-graduated scale for full 360° position recording. The voltage supply for meter indication is solid state and regulated in a range of 105 to 129 volts to assure accuracy regardless of wide line voltage or load variation. A rock-bar switch permits dual-speed rotor control with accuracy and ease.

Voltage input is 117 volts ac, 60 Hertz, ±12 volts; mast-mounting size range is 1-3/8" o.d. to 2-1/2" o.d.; cable is 6 conductor. Total shipping weight (rotator with 2 pair brackets and control) is 17 lbs. For further information, contact *The Alliance Manufacturing Company, Inc., Alliance OH 44601.*

CSC DM-3 DESIGN MATE® NULLING R/C BRIDGE IDENTIFIES JUNKBOX AND ANONYMOUS PART VALUES

Where unmarked, unreadable, or unknown component values are a problem, the Continental Specialties Corporation Model DM-3 Design Mate® provides an inexpensive solution. This compact R/C bridge with its solid-state null detector provides a level of performance beyond its $74.95 price. $74.95 price.

"Hi" and "Lo" LEDs lead quickly to an exact null with the unknown part in the bridge. Resistance is covered in 6 ranges, from 10 Ohms to 10 megohms; capacitance in 5 ranges from 10 pF to 1 uF; and the dial accuracy is better than 5%.

The DM-3 comes completely assembled, tested, and calibrated, with detailed instructions and special application notes. It weighs just 2 pounds and needs only 3 Watts at 117 V ac, 60 Hz. A 220 V ac 50/60 Hz model is available at a 10% additional cost.

The DM-3, other CSC Design Mate instruments, and other Continental Specialties Corporation products are available at leading electronics dealers and distributors, or direct from the factory.

For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.*

MOTOROLA ANNOUNCES LINEAR, WIDEBAND COMPLEMENTARY AUDIO DRIVER TRANSISTORS

A series of NPN/PNP audio power driver transistors in popular TO-220 packages from Motorola produces low distortion and good transient response because of current gain linearity specified and

Continued on page 47

The Alliance HD-73 rotator.

CSC's DM-3 Design Mate® R/C bridge.

Improving the SWTPC UDI

—*self-preservation made easy*

James R. Avoli K3MPJ
1261 Brinton Road
Pittsburgh PA 15221

The most flexible piece of test equipment that I have ever used is the Universal Digital Instrument from Southwest Technical Products Corporation.* This is a series of kits which are designed to work together to form a basic set of digital test instruments (including a counter and a DVM, among others) at a very reasonable cost. The basic concept and design make the system so very flexible in itself that it almost defies true design changes. But each individual accessory can be modified to suit its owner. Furthermore, SWPTC even gives enough detailed circuit description and theory of operation to allow you to design your own accessories. The system is not without its limitations, however, and I will take two of these to task in this article.

The basic unit is known as the UDI mainframe. It consists of a 1 MHz crystal-controlled timebase, digital logic circuits, a four-digit display, and an overflow indicator. All the other kits are accessories that plug into this mainframe (one at a time) via two sets of ten-pin connectors. The first and most important phase of improvement deals with one of the plug-in kits.

The Protection Racket

The FC-3 is the frequency counter accessory, rated at 20 MHz. Whether or not you consider four digits at that frequency adequate for your needs, the price is right. I only use it at lower frequencies, anyway. The counter's only other drawback is the ease with which the isolation FET (Q1) can be wiped out by too potent an input signal. The first couple of zaps only got me to be more careful about what level of signal I applied to the input. But that, as you already may have guessed, wasn't very reliable. So I made three modifications to this instrument to help protect it from me. Refer to the schematic diagram in Fig. 1 throughout the following description.

The first modification was to install a pair of crowbar diodes to shunt the disastrous portion of an overly potent input signal to ground when it exceeds the diode's threshold voltage. In this circuit, the location of these diodes right at the gate of Q1 won't load down the circuit under test. However, the diodes must be very fast-switching devices if they are to conduct before the input signal can destroy the FET. I used 1N914s (GE-300) with success here.

The second modification was to change the value of R1 to limit the flow of input current. The value was changed from 100 Ohms to 600 Ohms, so the current flow would be restricted but the sensitivity wouldn't be affected too drastically. In actual practice, this value has met with success in relation to the added diodes.

The third modification was to install a transistor socket so that I could replace the FET more easily if these protective enhancements didn't work well enough to overcome my own faux pas! I used a junk box variety with success here, but remember that I'm not concerned with its performance at 20 MHz.

So far, I haven't had to

*The UDI is no longer being produced, but we offer this article as a thought stimulus to those who already have or may wish to acquire this rather different piece of equipment. The original price of the mainframe was $59.95. — Ed.

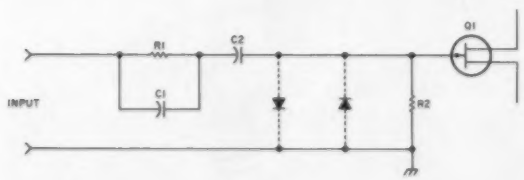


Fig. 1.

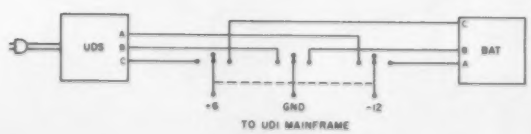


Fig. 2.

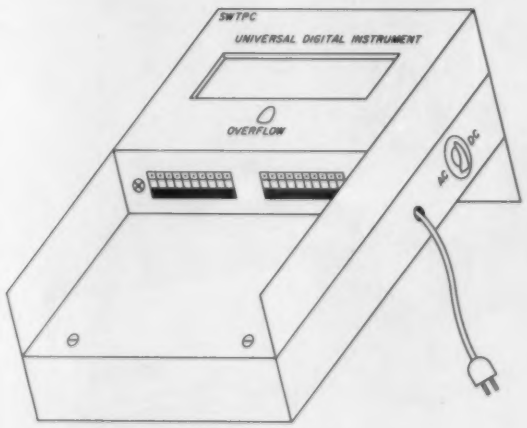


Fig. 3.

replace either the diodes or the FET. Incidentally, Radio Shack's #276-2035 (2N3819) N-channel FET does the job as a 99¢ replacement for the specified TIS-58.

Assault On the Battery

The second phase of improving the overall system was to alter the power source. Since I am more interested in versatility and ease of access for tuning and maintenance than I am in compact design, I undertook the next logical step. I acquired and built the UDS line supply kit, and then removed the batteries that are jammed into the mainframe. I combined the two power sources in a common chassis, along with a 3PDT selector switch, as shown in Fig. 2. You may even want to switch the ac line, thus requiring a 4PDT switch.

This second chassis, identical to the mainframe chassis, was then piggybacked, back to back, onto the mainframe. The back piece was then fabricated to double as both the rear cover and as a convenient tilt stand. See Fig. 3 for the mechanical denouement of this project. I have purposely used a sketch instead of a photograph for the following reasons:

1. The angle of slope is really up to you; design it to suit your own needs.
2. Alternate construction methods are to use a triangular rear cover or to build a separate sloped stand.
3. Even after all these years, the mechanical quality of my constructions has never been able to equal the electronic quality of my constructions!

Conclusion

As with any commercially-available product, there are always going to be ways to change (improve?) the original. I urge you to look into this flexible system of test equipment. Because of its cost and flexibility, you will find that it can open up a new horizon for you. ■

New Products

from page 45

matched between complementary pairs, and a 30-MHz current gain-bandwidth product. The series replaces popular types FT317 and FT417 with better peformance.

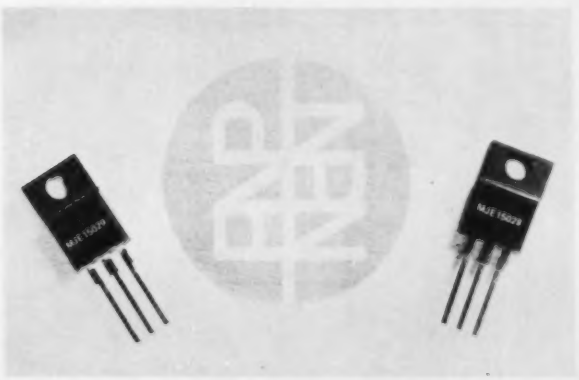
The 8-Ampere devices, available in 120-volt and 150-volt versions, exhibit gain linearity deviating only by a factor of 2:1 over a 0.1- to 3.0-A collector current range, with PNP/NPN linearity matched within a 3:1 ratio. Combined with wide bandwidth, these open-loop characteristics make excellent performance possible under closed-loop feedback conditions.

Capable of 50-Watt dissipation, the TO-220 plastic devices are available from stock at the prices shown in Table 1.

For further information, contact *Motorola Semiconductor Products, Inc., PO Box 20912, Phoenix AZ 85036; (602)-244-6900.*

Type	Polarity	$V_{ceo(sus)}$	Price (100-up)
MJE15028	NPN	120 V	$1.22
MJE15029	PNP	120 V	$1.22
MJE15030	NPN	150 V	$1.40
MJE15031	PNP	150 V	$1.40

Table 1.



Motorola's audio driver transistors.

NEW REALISTIC SOUND LEVEL METER

Noise may be a minor irritant, a definite disturbance, or even a threat to your hearing, depending on the level and duration, according to Radio Shack.

The new Realistic Sound Level Meter from Radio Shack may be used for measuring sound intensity in homes, schools, offices, or other environments for compliance with noise standards established by federal, state, and local agencies. It can also be used to check the acoustics of studios, auditoriums, and home hi-fi installations.

The hand-size meter features a weighting selector for measuring either wideband sound level ("C" weighting), or the 500- to 10,000-Hz range ("A" weighting), which is the area of greatest sensitivity to the human ear.

A range switch selects six sound-level ranges, each spanning 16 dB, for an overall range of 60 to 126 dB and includes a position for checking battery condition. The meter also has a slow/fast response switch for checking average or peak noise levels.

Other features include the large, easy-to-read calibrated meter and tripod adapter that allows the sound level meter to be mounted on a camera tripod (¼" thread) to eliminate hand noise and minimize the effects of sound reflected from your body.

A phono-type output jack permits use of the sound level meter as a high-quality, dual-response microphone, or for connection to high-impedance headphones, an oscilloscope, frequency analyzer, or other test equipment.

Accuracy of the Realistic Sound Level Meter is said to be ±2 dB at 114 dB sound level, and measurements are referenced to a 0.0002 ubar standard. Distortion is given as less than 2% at 1 kHz, 0.5 volt.

The meter is 6-1/4" x 2-7/16" x 1-3/4" (160 x 62 x 44 mm) and

Continued on page 49

Realistic Sound Level Meter.

Gary L. Edgington WB6EKO
12251 Buckskin Tr.
Poway CA 92064

Graduate to a Better Operating Desk

—*lots of class*

A couple of months ago, I came home from a long day of work all set to relax out in the shack and work a few guys on my trusty old Swan. After a brisk hello and good-bye to the XYL, I headed straight to my desk, sat down, moved a few things here and there to get at the key, turned on the rig, and sat back to let it warm up a little.

It took a second or two for it to sink in that I'd actually had to move things around in order to get enough operating space to do what I like best, which is working DX via CW. So, after a couple attempts to get through the worst QRM I'd seen in quite awhile, I started sketching out a desk design to suit my needs.

I like something flashy, yet simple and inexpensive and unique and functional at the same time. After getting a rough copy on paper, I thought others might like the design as well. This draft is not meant for minimum cost nor is the emphasis on shooting the moon; it's more a middle-of-the-road design. With a little research and imagination, you can add or delete as you see fit.

First, you'll notice that the desk is divided into two sections. Unless you're planning to make this a permanent fixture, don't try to move a 4'3" desk through a 28" door. It's been known to be downright difficult.

The lower section of the desk is very simple. I'm using 1" x 2" x 12' pieces of pine, as in Fig. 1(a), cutting and staggering these pieces. This, incidentally, makes a very handsome finish for this desk. I recommend nailing and gluing these strips together, except for those pieces used for the facing.

The sides can be made the same way, or you can use 3/4" (fine-grade) plywood. The backing, C in Fig. 2, is of 3/8" (shop-grade) plywood with the knots reversed to the back. Frame the backing with 1" x 2" pine for rigid support of the desk top.

All doors and drawers are made of 3/8" (fine-grade) plywood. There are too many ways to describe the construction of drawer slides, so I'll leave this to your own ingenuity.

The top section, made much the same way as the lower, is purposely made separately. Again, unless the entire desk is made as a

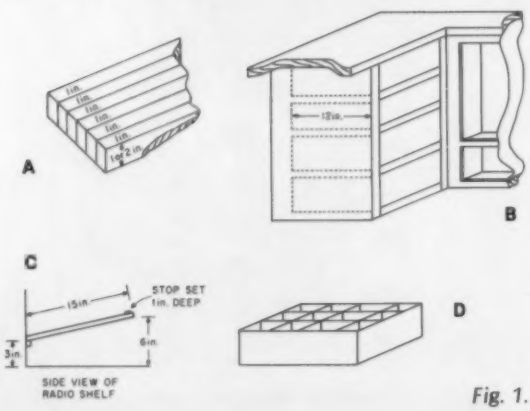


Fig. 1.

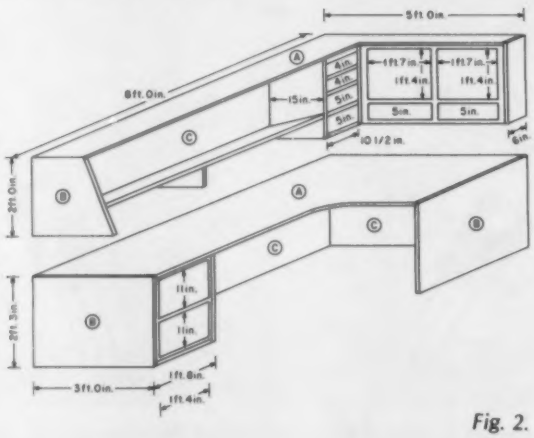


Fig. 2.

permanent structure, follow the drawings. Once set on top of the desk, it can be anchored by any of several different ways. The main idea is to be able to take it apart when you're ready to move.

In Fig. 1(b), I've left 3 inches of space for coax and electrical wiring. In Fig. 1(c), an old idea of slanting the radio shelf was incorporated into the desk for easier readability of dials and meters. Beneath this shelf is ample space for storing keys, logs, paper, pencils, and, in some cases, swr meters, all within reach of the operator but out of the way.

Box dividers, such as in Fig. 1(d), if made 2¼" to 2½" high, can be placed one on top of the other inside a couple of drawers for storage of small items. The cabinet space was purposely made narrow to maximize desk work space, but it is still ample for storage of hand tools either by hanging or laying them in the shelf space.

A folding bench can be added to the desk top next to the cabinet end by using a sturdy piano hinge and folding legs to save on space when it's not in use.

Finishing can be done in any of a number of ways. If you wish to use an enamel paint, you won't have to make such an elaborate desk top. If you wish to use a stain, I definitely recommend using spare pieces of the same wood to test for desired results. I'm using Varathane liquid plastic for a durable finish.

I've almost finished my desk and certainly hope you enjoy your desk as much as I intend to enjoy mine. Take your time, and best of luck to you. ■

New Products

from page 47

weighs 7-3/4 ounces (220 grams). It operates on a standard, self-contained 9-volt battery.

The Realistic Sound Level Meter is priced at $39.95. Available exclusively from Radio Shack stores and dealers, nationwide.

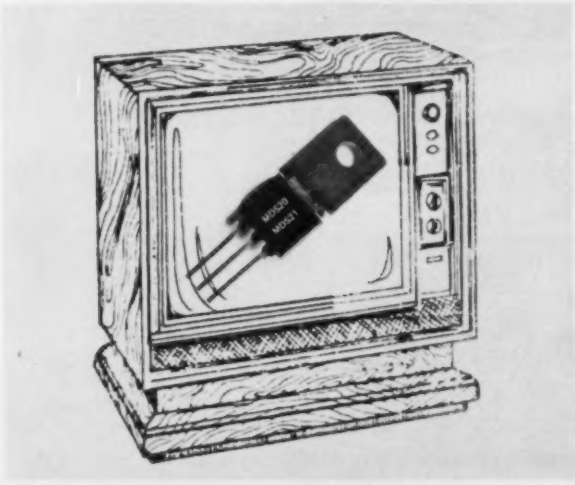
Radio Shack, 1400 One Tandy Center, Fort Worth TX 76102; (817)-390-3272.

RUGGED TV VIDEO OUTPUT TRANSISTORS IN INEXPENSIVE DUOWATT PACKAGE

Motorola's new MDS20 and MDS21 high voltage power transistors combine a high 60-MHz current gain-bandwidth product with the ability to withstand cathode ray tube arcing currents in the economical, 2-Watt free-air dissipation Duowatt package.

The MDS20 ($0.50, 100-up) is rated at a c-e breakdown voltage of 250 volts, while the MDS21 ($0.55, 100-up) achieves the 300-volt breakdown needed for higher-powered color TV designs. Saturation voltage is better than 0.6 V at 30-mA collector current. The gain is specified at a minimum 40 at 30 mA, with linearity from 1 mA to 40 mA. The low collector-base capacitance (3.0 pF max) eases video and chroma output design problems, while small drive requirements allow the transistor to be directly driven by many types of IC chroma demodulators.

Used as a color difference output, where drive and bandwidth requirements are less severe, the MDS20 and MDS21 can safely be operated without any heat radiator to ambient temperatures of 112°C. The plastic Duowatt package provides a metal tab for those applications where heat sinks are required. For further information, contact *Motorola Semiconductor Products, Inc., PO Box 20912, Phoenix AZ 85036; (602)-244-6900.*



Motorola TV video output transistor.

CSC INTRODUCES 500-MHZ PRESCALER FOR $59.95; EXPANDS COUNTER RANGE TEN TIMES

Continental Specialties Corporation introduces their 500-MHz Prescaler which is capable of extending the performance of almost any frequency counter ten times, up to at least 500 MHz.

It features a BNC input connector, diode protected 50-Ohm input, and 250-mV sensitivity from 50 to 500 MHz. Its output is a minimum 400 mV (peak-to-peak) capacitively coupled signal, available at a phono jack connector. Direct or ÷10 prescale outputs are switch-selectable.

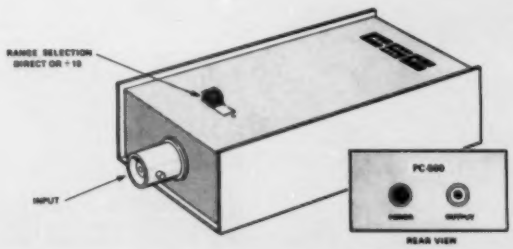
Power is supplied to the unit through a coaxial dc-type power connector. Power requirements are 7-12 V dc at 100 mA maximum. An on-board voltage regulator assures trouble-free operation even from troublesome power sources.

The entire PS-500 package is 1" x 2" x 3½". Suggested price in unit quantities is $59.95. Available accessories include 110 and 200 V ac power supplies—each $9.95; a power connector-to-alligator clip cable at $2.95; a cigarette lighter power cord at $3.95; a 3-foot BNC-to-BNC input cable at $5.95; and a 3-foot phono plug-to-phono plug output cable at $3.95.

The PS-500 interfaces directly with CSC's MAX-100 MHz frequency counter ($134.95), and their new Mini-Max 50-MHz hand-held frequency counter ($89.95) to extend the counting range of either counter. In addition, it can be used with almost every counter available.

The high-speed performance of the PS-500 is specified and guaranteed to 500 MHz. Typically, the ECL-III logic used in its design is capable of reliable performance up to about 600 MHz. This 500-600-MHz performance, in combination with its low price, suggests the PS-500 for a number of VHF applications, including radio common carrier, aviation radio, amateur radio, business radio, government and public service radio, telephone, marine radio, television, navigation, radar, and other communications applications;

Continued on page 60



CSC's 500-MHz prescaler.

The SWL Bible

—*tuning the ends of the world*

Most larger stations will put you on their mailing lists for programming schedules and other literature. To stay on, you have to show them you are still alive with an occasional reception report or letter indicating an interest in receiving the mailings.

Thomas R. Sundstrom W2XQ
Box 205
Willingboro NJ 08046

A wide range of programming, from pure propaganda to strictly local business, can be found on the air. The international bands above 6 MHz are populated with high-powered (100 kW or more) "voices" of governments disseminating news and commentary cast in the mold of the democratic western world or of the communist bloc or somewhere in between. Stories broadcast by the United States Information Agency's Voice of America, Radio Moscow, and the neutral Swiss Broadcasting Corporation take on remarkably different flavors even though the same incident is the particular item under comment. Interesting opposing versions of events in the Middle East are offered regularly by the Israel Broadcasting Authority and Radio Cairo.

The large stations also broadcast other kinds of programs. The British Broadcasting Corporation offers a host of dramas, game shows, and sporting events. One of the most popular programs on the air is the Music USA and Jazz Hour aired by the Voice of America, Washington. And guess what—no commercials!

In addition to government-sponsored stations, there are a number of religious stations on from such countries as the Philippines, Ecuador, Liberia, and Ethiopia. Of all such outlets, HCJB in Quito, Ecuador, is probably the largest and best known, programming in a variety of languages to all areas of the world.

International broadcasts are in all languages, but the bulk of them directed to North America are in English. Broadcasts are directed to all continents, even Antarctica, by governments on all continents—with the notable exception of South America, which has been the slowest to get into the fracas.

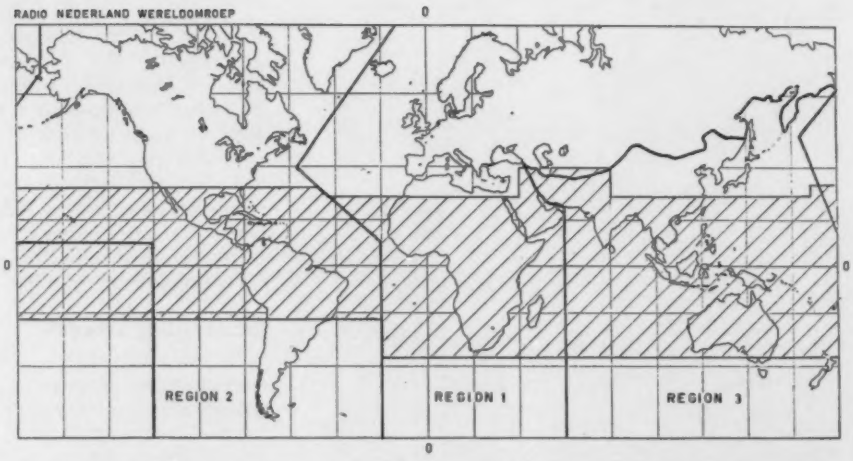


Fig. 1. This map depicts regions I, II, and III as established by the ITU. The crosshatched center section shows the area of the world in the tropical broadcasting zone. The map is from the "Radio Spectrum Course" offered by Radio Nederland, Hilversum, Holland; enrollment in the course is free for the asking.

A third type of broadcast consists of the regional and local ones found in the tropical bands below 6 MHz. These frequencies are called the tropical bands because the bulk of the stations using them to penetrate the back country, out of the range of conventional medium-wave (standard AM broadcast) stations, are located between the Tropic of Cancer and the Tropic of Capricorn.

The regional broadcasts are quite interesting because programming is untainted by international politics, but most of these low-powered outlets are not in English. Particularly in Latin America, many of these stations are privately owned and relay MW outlets. Many of the African tropical voices provide interesting DX challenges for North America-based listeners. Conveniently, the best opportunity for hunting the Africans is just before the dinner hour and just after the late television news.

I'm getting ahead of myself. To have an understanding of SWBC listening, there is a universal "language" that has to be learned. It's not complicated, but it is necessary. So let's look at some terminology, get an idea of what can be heard, and conclude with some information on publications and equipment.

Frequency Factors

If you have a ham license and are active on the low bands, you are already aware that frequencies can be expressed in terms of meters (m), kilohertz (kHz), or megahertz (MHz).

Most "voices" nowadays have updated their announcements and use kHz, but watch out for the eastern Europeans. Most of these government-controlled stations still announce frequencies in meters, expressed to two decimal places.

You'll have to do the conversion:

$$m = \frac{300{,}000}{kHz}$$

or

$$kHz = \frac{300{,}000}{m}$$

Rounding errors will occur when calculating the exact frequency, but you'll be within 5 kHz of the actual frequency.

Let's Get High

The high frequency region, above the standard AM broadcast band and below the public safety bands used by police and firemen, is transitory in nature, exhibiting all modes of propagation at one time or another; this is the area with which I will be concerned in this article.

High frequencies (HF) are the only consistent frequencies to "bounce" off the various layers in the ionosphere with any degree of predictability, and the competition for space is fierce.

Fixed (point-to-point utility) services, both government and private common-carrier, occupy over 10 MHz, and mobile services (aeronautical and marine) take up another 5 MHz. Broadcasters and amateurs are low on the list, with 3 or 4 MHz each.

As the underdeveloped countries, especially in

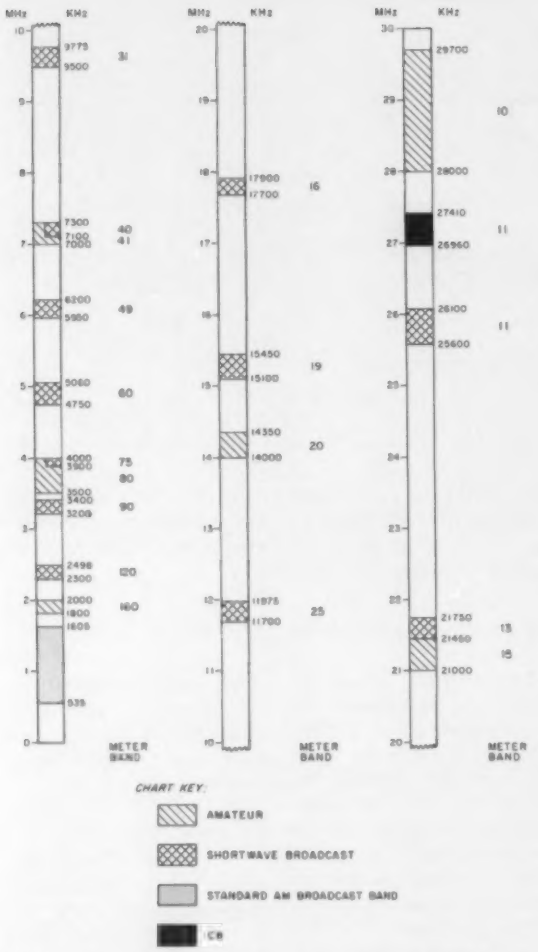


Table 1. A simplified radio spectrum shows the placement of the shortwave broadcast bands, the radio amateur bands, the CB band, and the domestic AM broadcast band tuned by most general-coverage receivers. The blank spaces are occupied by fixed (utility) and mobile (aero and marine) stations, for the most part.

South America and Africa, expand their economic muscle, their collective impact and need to be heard will put an even greater demand upon the available frequency space. Back in 1934, when the present International Radio Regulations were adopted by the International Telecommunications Union, things were quite different, and such pressures did not exist. Table 1 depicts the HF spectrum with frequency allocations for today.

Time Constants

Broadcasting schedules are referenced to the standard Greenwich Mean Time. GMT or Universal Time (UT), which is the same thing for our purposes, is expressed as a 4-digit number in a 24-hour clock. Don't forget to adjust day and date when converting.

If you are active on the low bands, you are already probably keeping your log in GMT. If you are a newly-licensed Novice or active only on VHF, just tune to WWV on 2.5, 5, 10, or 15 MHz and you'll hear the time given in GMT each minute.

The reason, incidentally, that international broadcasters use the 24-hour GMT clock is that it would be virtually impossible for them to keep up with the ever-changing Daylight-to-Standard-and-back conversions that take place worldwide. Recent changes in past years just here in the US exemplify the problem.

Broadcasting Schedules

Broadcasters are alert to ever-changing propagation conditions. The maximum usable frequency (MUF), above which signals will not be reflected by the ionosphere, and the optimum traffic frequency (having ionospheric support 90% or more of the time), which is lower than the MUF, are affected by three cycles: a daily, a seasonal, and an 11-year cycle.

Short-run variations, caused by solar storms, resulting in radio blackouts and stupendous displays of the northern and southern lights, only add spice to the everyday life of the broadcaster.

Most broadcasters will change transmitting frequencies quarterly to compensate for the fairly predictable seasonal changes.

International frequency coordination has been carried on, since 1960, by the International Frequency Registration Board (IFRB) of the International Telecommunications Union (ITU) in Geneva, Switzerland. Broadcasters must submit quarterly schedules in advance of their intended use. The four periods are the March schedule (March and April), the May schedule (May through August), the September schedule (September and October), and the November schedule (November through February). Each schedule starts on the first Sunday of the month. The proposed schedules are required by the IFRB five months before the expected implementation date.

The IFRB assembles all the submitted information into a tentative schedule and distributes it to ITU members about two months prior to implementation date. The IFRB points out problems and suggests alternatives to resolve on-the-air conflicts, and there is time to make adjustments and negotiate terms if the problem is unusually difficult.

At the conclusion of the period, a final HF master schedule is compiled showing which frequencies worked and which did not. The broadcasters can use this hindsight to prepare future proposed schedules. Any time a frequency, either during the proposal period or on the air, is changed, the broadcaster must inform the IFRB.

The work of the IFRB has reduced the number of on-air conflicts, but they're not able to address out-of-band operation.

It should be noted that the frequency allocations in Table 1 are those established by the various conferences, but that a number of countries do not follow the ITU regulations and will slide up or down a bit as they did to escape the interference that was especially bad during the bottom of cycle 20-to-21. The communist bloc countries are noted for sitting on or outside the band edges.

The Broadcast Bands

The various bands have unique personalities and can offer different DXing challenges, so let's look at what the ITU is dealing with.

120m (2300-2498 kHz)

This tropical broadcast band is dominated by low-

powered stations in Latin America and Indonesia, with a few Africans thrown in for good measure. On the west coast, Indonesians can be heard before dawn, but, elsewhere, you can hear Guatemalan outlets on 2360 and 2390 or Brazil on 2470 and 2450 kHz. On the east coast at sunset, listeners may log the most powerful station on this band—the 20 kW Rhodesian outlet on 2425 kHz, scheduled 0355-0445 GMT.

90m (3200-3400 kHz)

Another tropical band, used for low-powered relays of medium-wave stations but intended for an audience in the hilly country of Latin America or the bush country of Africa, this band is dominated by stations in some pretty rare countries. The beginning DXer will first note the powerful voice of the 24-hour South African Broadcasting Corporation, the domestic voice, on 3250 kHz. Sunset would be the best time to hear other Africans, such as Swaziland on 3223, Liberia on 3255, Rhodesia on 3306, and Sierra Leone on 3316 kHz. After the Africans sign off, stations from Guatemala, Brazil, and Venezuela populate the airwaves; a popular station is the English-speaking Belize on 3285 kHz. On the west coast, Indonesians, Chinese, and Indians can be heard before dawn.

75m (3900-4000 kHz)

This band is classified as an international band in regions I and III, with region I restricted to just the top 50 kHz. Region II amateurs, who share the frequencies, complain bitterly, but there is no foreseeable change except, perhaps, a lessening of the interference as we get into cycle 21 and broadcasters move to the optimum traffic frequency that should get up to 25 or 19 meters at night. Now, Radio RSA, South Africa, and Deutsche Welle, German Federal Republic, share 3995 kHz. Other easy-to-hear stations are the Swiss Broadcasting Corporation on 3985, the British Broadcasting Corporation on 3975 and 3952, and the South African Broadcasting Corporation outlets on 3980 and 3965 kHz. The low-powered Far Eastern outlets between 3900 and 3950 kHz can be heard before dawn on the west coast, when interference from east coast stateside amateurs is the lowest. One of the most interesting challenges now on 75m is Radio Afghanistan, heard around 0200 GMT on 3999.8 kHz.

60m (4750-5060 kHz)

WWV and other time and standard frequency stations mark this band by occupying the exact frequency of 5 MHz. This band is probably the most productive tropical band for the experienced DXer. On the east coast, Africans fade in an hour or two before sunset, and countries such as Benin on 4870, Guinea on 4910, Ivory Coast on 4940, Cameroon on 4972, the Central African Republic on 5039, and Togo on 5047 can be heard. Colombians and Venezuelans dominate the band after the Africans sign off, but, by 0400 or 0500 GMT, most of these powerhouses have also gone off the air, leaving clear frequencies for the low-powered outlets in Peru and Ecuador. Africans can be heard once again signing on after midnight, before dawn on the continent. Around 1100 or 1200 GMT, DXers have a chance to log such things as Burma on 4725 or Indonesia on 4767, providing that solar conditions are "quiet" enough to permit a trans-

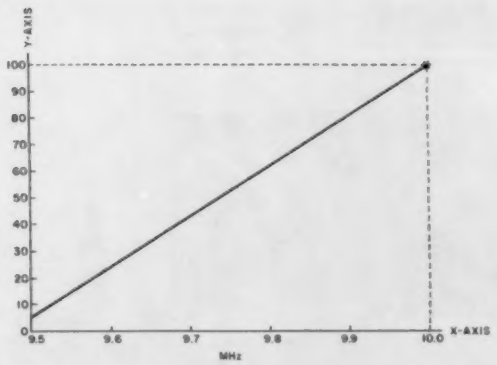


Fig. 2. Band calibration charts can be prepared for each frequency range you want to tune. A calibrator is a useful tool in making accurate graphs. A graph for 31 meters should look something like this.

polar path. Of all the outlets in Oceania, the easiest to hear is Port Moresby in English on 4760 kHz, whose signal peaks about an hour before local sunrise on the east coast. And let's not forget a country most hams would love to work—Galapagos Islands, on 4810 kHz, which has been widely heard lately up to 0400 GMT following the sign-off of the Venezuelan that controls the frequency during the early evening.

49m (5950-6200 kHz)

This is the lowest international band used in all three regions, but, among the superpowers, there are still elements of a tropical band within. In the middle of the day, low-powered Canadians (relaying AM outlets) can be heard on 6005, 6010, 6070, and 6130 kHz and, in the Gulf states and the southwest, some Mexican and other Central American stations may be heard. By late afternoon and into the late evening, however, Europeans and Africans totally dominate almost every frequency. Not until sunrise in Europe does the congestion begin to ease, and some low-power Latins can be heard prior to dawn stateside. Australian outlets on 6140 and 6150 kHz are best heard around 1000 to 1200 GMT.

41m (7100-7300 kHz)

This band is assigned to broadcasters based in regions I and III only, and international broadcasters are not supposed to beam programs to the western hemisphere. Unfortunately, many do, and the entourage is led by Radio Moscow, with as many as six frequencies in parallel operation. Unfortunately, the Novice, restricted to 7100-7150 kHz, has to bear the brunt of the interference with Moscow on 7105 and the Tirana relay of Radio Peking on 7120 kHz leading the way. Out-of-band operation is notable here, especially with multi-language programming of Tirana on 7065, heard as early as 1900 GMT, and the British Broadcasting Corporation during the late afternoon on 7075 kHz. One of the more interesting stations noted on 41m is Radio Pakistan on 7095 kHz, noted with good signals on an English language transmission to Europe at 2100-2145 GMT. West coast DXers will also hear the Asiatic Russians, Chinese, and Manilans on 7225 kHz before dawn around 1000-1100 GMT.

31m (9500-9775 kHz)

This is the first of the in-

Colorful verification cards can be obtained from most of the shortwave broadcasting stations. Note the self-prepared card in the lower right-hand corner. That was for a reception report of Radio Swan on 6000 kHz in 1960, a front for the CIA operation on Swan Island prior to the Bay of Pigs fiasco.

ternational bands that has something audible on it 24 hours a day. At sunrise, Chinese and Australian broadcasters dominate (look for Radio Australia 1100-1300 GMT on 9580 kHz), but, by late morning, high noise levels preclude hearing most signals excepting those from Cuba, Haiti (on 9770 kHz), and HCJB in Ecuador. Europeans and Africans fade in by midafternoon and peak during the dinner hour on the east coast. Tuning signals, which are characteristic melodies unique to each broadcaster and precede the opening of transmission, can be heard every half-hour. By midnight, all that will be left are some of the western hemisphere broadcasters, except, if conditions are right, VLW9, Perth, may be logged on 9610 kHz in a transmission beamed to the South Pacific. On the west coast, the regional and general service broadcasts from Japan and China can also be heard.

25m (11700-11975 kHz)

This is another mainstay, with the band center loaded with the European and African powers. Morning openings to the Far East and Oceania will usually turn up numerous Soviet and Chinese regional services found above and below the nominal band edges. Now, the afternoon and early evenings are best for Europe and Africa, but, with the move into cycle 21, this band should remain open later and later into the night. After 0300 or 0400, look for the south sea music of Tahiti in French on 11825 kHz and for New Zealand on 11705 kHz. The relatively low-power Brazilians populate this band and can be heard best after 0000 GMT on 11785, 11805, 11865, and 11915 kHz, as well as elsewhere.

19m (15100-15400 kHz)

During the summer, this band can stay open all day, with Europeans in the morning and Asia/Oceania in the late evening into the night. Tahiti's second outlet on 15170 often is better than the parallel outlet on 11825 kHz. Peking can be found on 15030, 15045, 15060, 15070, and 15080 kHz, and, usually 15060 or 15080 kHz has an English-to-North America beam repeating each hour for four or five hours commencing at 0000 or 0100 GMT. Japan beams English to North America's east coast at 2345-0045 GMT on 15270, 15300, or 15445 kHz. During the middle of the day, as a contrast, only the major countries are heard, with Cuba and HCJB, Ecuador, predominant.

16m (17700-17900 kHz)

This band, at the minimum between sunspot cycles 20 and 21, was very uninteresting, but is now open into the late evening. Europeans and Africans (notably Cairo) can be heard in the late morning. HCJB's programming to Europe can be heard during the afternoon. Radio Australia's North America beam at 0100-0300 GMT on 17795 kHz and Japan (17825, 2345-0045 GMT) are audible during the evening.

13m (21450-21750 kHz)

Another daytime band with only the superpowers such as the British Broadcasting Corporation, Radio Cairo, and the Voice of America, this makes for another dull band from a DXer's point of view. This band should become quite active as cycle 21 peaks around 1980-81, as forecasts indicate the adjacent 15 meter amateur band will be the mainstay for DXers.

11m (25600-26100 kHz)

Until late 1977, this band was just plain dead, but cycle 21 should bring it to life as a daytime-only proposition. One of the first occupants was the Israel Broadcasting Authority, running 1400-1630 on 25605 kHz in Russian, Yiddish, and Georgian. Due to the seasonal variations of the MUF, 11m will be best during the summer months.

Information Sources

There are more than 20 nonprofit clubs in North America publishing monthly bulletins packed with information on members' loggings of up-to-date frequency and time changes, new "voices" on the air, and tips on improving your DX listening post. Some clubs specialize in a particular aspect of DXing, whereas others cover a broad range of interests.

Most clubs are members of the Association of North American Radio Clubs (ANARC). In addition to being a unified voice for publicity of the hobby, ANARC has a number of committees: frequency recommendation (to advise on clear frequencies for North America-beamed broadcasts); technical (to encourage receiver manu-

facturers to install SWL-oriented features); and a representative to the FCC Broadcasting Service Working Group working on the WARC 1979 proposals.

ANARC offers a current list of all ANARC members, free upon receipt of a no. 10 self-addressed stamped envelope with 28¢ postage affixed. The data sheets detail the main interests and publications of each club, the cost of membership, and a sample bulletin. When you write ANARC, 557 North Madison Ave., Pasadena CA 91101, requesting the list and enclosing the SASE, tell them *73* sent you.

Whereas a club bulletin is essential for current information on changing broadcasting schedules, other, more static, information must be obtained elsewhere. One such source is the annual *World Radio TV Handbook* available through Gilfer Associates, Box 239, Park Ridge NJ 07656. All kinds of data—addresses, personnel, master schedules, tuning signals, and more—are included. As the *Callbook* is the authority for radio amateurs, so is the *WRTH* the book for shortwave broadcast listening.

Another source of DX tips is through the "DX shows" aired by a number of different broadcasters. The *WRTH* has a master list of those, and the club bulletins keep you up to date on changes in the airing of them. There are some excellent "DX shows" produced by Radio Australia, Radio RSA (South Africa), Radio Sweden, and Radio Nederland.

Reception Reports and Verifications

Just as the radio amateurs on the HF bands exchange QSL cards to "prove" or "confirm" a QSO, so do SWLs write reception reports to broadcasters to elicit a verification card.

The data in the ham QSL and SWL report is much the same—date, time in GMT, and frequency—but the SWL report has an added description of the program content which should normally be 30 minutes long as a minimum. In addition, a few sentences on signal quality and interference are in order, unlike the RST format used by hams.

If the report can be verified against the program logs, the writer can usually expect a verification card in the return mail. A few stations still send letters, and a few others—notably Canada—no longer send QSLs.

Some stations depend upon a technical monitoring staff, which is derived from those listeners' reports showing the most value and a consistency in reporting. Radio RSA and Radio Japan are two such examples, each maintaining a network of monitors to whom they provide advance news on schedule changes, special newsletters with some "inside" information, and reimbursement for postage.

By the way, unlike the radio amateurs' QSL bureaus, SWLs have no such clearinghouse and reports must be sent directly to the stations. Return postage is often not required by the larger governmental outlets, but the smaller stations do require International Reply Coupons or mint stamps. When in doubt, always send return postage of some sort.

Accessories

If you have one of the new digital readout receivers or something like the very popular Drake SPR-4 receiver, you may not be interested in adding anything to your shack. However, if you are using one of the older receivers—Hammarlund, Hallicrafters, and National used to dominate the market in the 1940s, 1950s, and 1960s—there are a number of devices to facilitate DXing.

A must is to be able to tell what frequency you are tuned to. The add-on 100 kHz calibrator is almost passé now, as there are a number of manufacturers marketing calibrators that put out markers down to every 5 kHz for less than $40.

A calibrator is used to set up a reference marker on a 0-100 bandspread dial where, for example, 10 MHz is set to equal 100. On a sheet of graph paper, mark the x-axis with the frequencies of 9.5, 9.6, 9.7, 9.8, 9.9, and 10 MHz. Mark the y-axis with 0, 10, 20 . . . 90, 100. The calibrator will give precise markers at, say, 25 kHz as the bandspread dial is turned from 100 to 0. Plot the points and connect them for a visual graph of the 31 meter band. See Fig. 2.

When tuning the band in the future, just set the top end to have 10 MHz coincide with the bandspread dial at 100. The graph will get you into the ball park and the 5 kHz markers will enable you to fine tune any frequency by counting markers from the nearest 25 kHz point.

In a similar manner, other graphs can be made up for any band desired. It doesn't take long. Use 10 x 10 log paper to make interpolation easy.

An alternative to this is to add digital frequency readout. It is more expensive and, to date, there hasn't been much available unless you build your own from scratch. Digital frequency readout is really nothing more than a frequency counter with the added ability to offset a receiver's intermediate frequency.

For example, if the i-f is 455 kHz and you are tuned to a broadcast station on 1000 kHz, the counter will normally display 1455 kHz. If the counter has five digits to the left of the decimal point, the offset has to be 99545. When 1455 is added to the 99545, the counter with an offset calculates 101000. Given a five-digit display, the sixth digit (the "1") will be lost and the proper frequency—1000 kHz—will be displayed.

The problem is that counters which have the ability to load in any offset are rare and expensive. The breakthrough on the cost front may have been made, however. David L. Mattis describes a "Digital Frequency Readout for Shortwave Receivers" in the February, 1977, *Popular Electronics*; a kit of parts is available for $110.

As calculators have dropped in price over the recent years, I am sure that technology will soon lower these prices as well.

Another useful accessory is the active audio filter. One of the best ones for shortwave listening is the Autek Research (Box 5127E, Sherman Oaks CA 91403) QF-1, which has a variety of controls for selectivity and heterodyne rejection. The problem with many of the other filters commercially produced is that they are designed for CW only and cannot be adjusted to optimize AM reception.

Properly adjusted, an audio filter can make a poor or mediocre receiver "sparkle" in heavy interference conditions. Most filters are outboard and can be moved from receiver to receiver; connection is through a headphone plug into the receiver, and the speaker or headphones are plugged

into the audio filter.

For the shortwave listener trying to listen to broadcasts on 75 or 41 meters, or for the radio amateur trying to copy CW or SSB through the broadcasters, a good audio filter can do the trick. I can either notch out a CW heterodyne or roll off the tonal response to diminish SSB splatter when listening to the broadcaster; as a Novice, I tightened up the filter's bandpass and frequently worked within 1 kHz of the broadcaster's carrier frequency.

Don't forget that most receivers offer a 400 Hz CW filter, but a decent active audio filter can cut that bandpass down to 80 or 100 Hz, and that makes a big difference. There is one company on the west coast that offers a filter for Drake receivers, replacing the 400 Hz filter with one at 125 Hz, but that has to be wired in and costs about $125. It's good for the CW DXer, but not so good for the broadcast listener, so pick and choose carefully.

Another interesting device is the panadaptor. Unfortunately, commercial units manufactured today are very costly, but there are still a number of the Heath SB-620 pieces around for about $100 to $125.

The panadaptor visually displays, on a cathode ray tube (CRT), the receiver's i-f bandpass. Depending upon the settings, the SB-620 displays as little as 6 kHz (±3 kHz) or as much as 100 kHz (±50 kHz), centered on the i-f. Adjacent frequencies, occupied or empty, are readily seen, and the culprit causing the adjacent channel splatter cannot hide from view. With a 5 or 10 kHz calibrator, fairly precise frequency measuring can be done by displaying pips on the CRT and calibrating the baseline through the setting of the panadaptor controls.

If you pick up one of the SB-620s, try to get the extra coils that came with the unit. Heath provided a number of wiring options depending upon the receiver i-f. The Heath gear of the SB-series was set up on 3395 kHz, but it could be wired for anything from 455 kHz to 5200 kHz.

Another useful trick is to add a tape recorder jack to the receiver. The easiest way to do this is to mount a phone jack on the rear apron of the receiver and route lightweight shielded cable (such as is used in turntable arms) over to the volume control. Solder the shield to the end lug that is grounded, and solder the center conductor to the opposing end lug.

If you've done the job properly, the taping level will be independent of the volume control setting. This exercise is useful when you want to tape something without listening to it live. An auto-level-control cassette tape recorder works quite nicely in this capacity.

As an aside, I use an ALC cassette tape recorder when CW DXing. I don't have to worry about level settings, and, if I miss a call or want to check on an unusual spelling of a name, I'll have it on tape to check.

For longer taping jobs, consider putting a reel-to-reel tape recorder on a timer when you are out of the shack. You can turn the receiver volume down, and your wife won't even know that something's running. The tape can be replayed at your leisure.

If you have a tape with a poor signal due to interference and heterodynes, just replay the tape through your Autek QF-1 or other audio filter until you find a setting that does the trick. Don't have an audio filter? Replay the tape through your household stereo system and adjust the bass, treble, and "cut" controls until you find a setting that cleans it up for you.

Antenna tuners are another useful tool for the serious DXer. You can roll your own or look at Gilfer's catalog. A couple of 365 pF variables, a coil tapped at intervals, and a rotary switch are enough to make up a simple tuner.

If you have an antenna tuner for your ham band work, you will probably find that your unit will have enough latitude to resonate your antenna on the adjacent broadcast bands. Just peak it for maximum S-meter deflection on the receiver.

Antennas

What can be said on this topic that hasn't already appeared in *73* or in the books distributed by *73*? One premise says, "Put up antennas resonant to each band you want to listen to." That's a lot of hard work, and I suggest something a lot easier.

Receiving antennas are a lot more forgiving than transmitting antennas, and I just try to put up as long a wire as possible. I like to get up something at least 100 feet long and then tune it as needed—the higher, the better, and don't worry about the twists and bends around trees. If you have an option, run the bulk of the antenna perpendicular to the adjacent power lines to minimize noise pickup.

As always, don't cross under or over power lines and don't attach the end to a power pole. Even though you are dealing with a receiving antenna, the same safety rules apply.

Can't put up a long wire? Mount a steel 102" CB whip on the roof, and feed the receiver through RG-58/U and an antenna tuner. A vertical up high, free of the ground clutter, can be a respectable antenna, although verticals are usually more susceptible to local electrical noise.

Obviously, if you are active on the ham bands of 160-10 meters, just make use of the antennas you have up now. You'll find that you'll still be able to take advantage of the ham band antenna's features. For example, the 15 and 20 meter segments of a tribander beam will still exhibit directional effects on 25 through 13 meters.

In Closing

The shortwave broadcast bands offer some interesting challenges for the DXer. Most broadcasters run higher power than most DX stations, and listening to of some "flagship" stations can give an indication of propagation conditions in the adjacent amateur bands.

If you have a regular schedule with friends in a far distant land, listen to the news broadcasts by that country's "voice" and you'll have more interesting QSOs through your knowledge of their environment.

If you travel overseas, most stations welcome visits from their listeners. You probably will strike up a dual friendship as a listener and an amateur, as no doubt you will find a number of licensed amateurs at the larger stations you visit.

Frankly, citizens of the United States are spoiled by an extensive array and variety of AM, FM, and TV stations on the domestic bands. Elsewhere in the world, there are some vast areas not served by any particular domestic service, and shortwave broadcasting provides much-wanted information for those "armchair travelers" in remote areas.

The world is at the end of your antenna—just tune it in! You'll be a more interesting person for it.■

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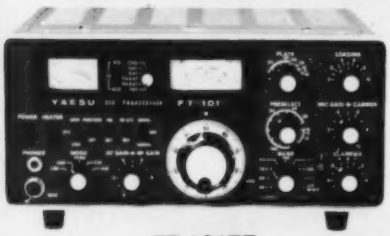
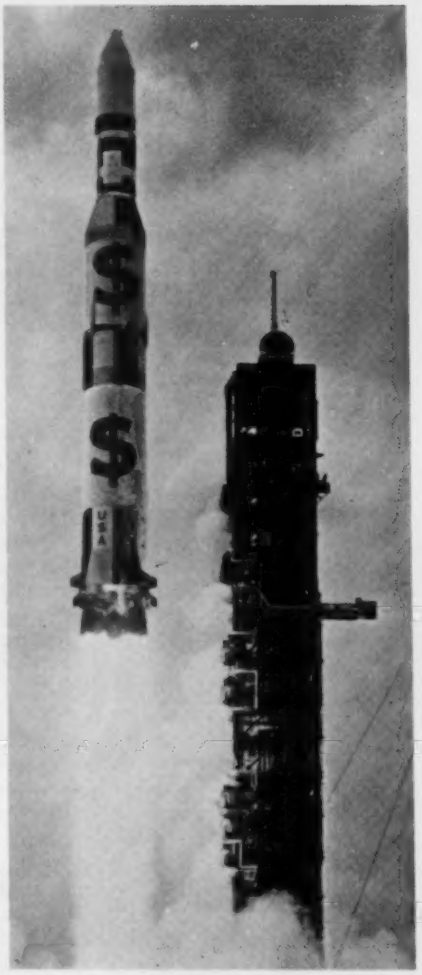


FT-101EE

Just one step down is the FT-101EE identical in every respect—but less the RF speech processor—an item many hams can live without, thus saving a few dollars.

FT-101EX

The FT-101EX is the same basic unit, less DC/DC converter, 160M, WWV, and three of four 10 meter crystals and the RF speech processor. Many hams do not need these features and would just as soon save the money. All accessories may be added later and the "EX" can then become an "E".



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The Mobile Dream Machine

—Kenwood, Drake, Larsen . . . and Ford

After purchasing a long-awaited Kenwood TR-7400A, Drake tone encoder microphone, and 5/8-wavelength Larsen magnetic-mount antenna, I decided to put my dream equipment into the family's 1972 Ford station wagon. The installation of this equipment was a nightmare for me, not because it was impossible, but because my profession deals with man-machine interaction and I had some rather stringent objectives:

1. Operation had to be convenient and safe whether I was driving the car or riding as a passenger in the front seat.

2. The wiring for the tone encoder had to be via the microphone jack rather than the accessory tone jack on the side of the 7400.

3. Coax had to be routed to the antenna with as little damage to the car as possible.

4. The mount and coax had to be secure and blend with the color of the car in order to please the XYL.

5. Scratching of the 7400's cabinet, side rails, and heat sink, due to insertion into the mobile mount, had to be minimized.

In order to enable easy installation and removal of the rig from the car, I decided to use a master connector panel. This is nothing more than a piece of sheet metal with all the necessary connectors on it for making connections to the rig. The panel is mounted close to the rear of the rig so that only short cables are necessary. Note that all connectors mounted on this panel must be insulated from ground and each other in order to avoid ground loop problems which, for me, initially appeared as alternator whine, ignition noise, etc. The only connection of the transceiver to ground should be via the negative power lead at the battery terminal and the coax braid at the antenna mount.

In order to be able to use the rig from anywhere in the front seat, I decided to mount it under the dash, in the center above the transmission hump. This tends to minimize spotting by thieves, but it's still best not to leave a rig in a car unattended. To further ease operation, I decided to run an extension microphone cable to the left side of the dash from the master connector panel so that the driver could use the microphone with his left hand and steer with the right hand. For right-handed drivers, this is safer, particularly when engaged in city driving with many turns and frequent use of turn signals.

By switching the microphone from the left side of the car to the center, anybody in the front seat can use the rig. A microphone holding clip is present in both locations. Also at the center of the dash on the master connector panel, where the microphone cable plugs in from the 7400, is a coax connector and Jones connector to allow easy hookup of the antenna and power leads.

This scheme, used with some flexible RG-8/U coax (Columbia number 1198, Superflex) gets the coax over to the antenna connector with no large bends. The antenna connector, on the master connector panel, is mounted with plastic washers to insulate it from ground.

It was immediately observed that the cable for the microphone had a large loop where it entered the front panel of the 7400; it looked bad and invited abuse. A 90-degree bend would solve the problem, only they don't exist. So I made one! It was necessary to use two connectors to make the bend, but it really improved the appearance.

For the ultimate in appearance, I decided that the power to and output from the tone encoder microphone should be routed via the 7400's front panel connector, not the tone pad jack on the side. It sounded simple. However, on-the-air reports said it was just about impossible. One fel-

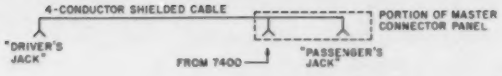


Fig. 1.

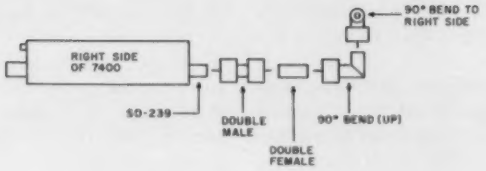


Fig. 2.

low said a local shop was doing it for $25. I looked at the photos in the owner's manual and could understand why. A phone call to Kenwood got me the scoop from a very courteous gentleman. My suspicions were confirmed—it can be done, but it takes time (a full 2 hours from plugging in the soldering iron to on-the-air use) and caution.

In addition to getting all the tools out, one would be wise to secure a magnifying glass, an X-acto™ knife, flashlight or high-intensity lamp, and jeweler's screwdrivers. Use these as needed. The project should start with a prayer; I don't think I could have done it otherwise. The following are the steps used, but they can be performed in any order; whatever order agrees with you is fine if it works. Placing the unit on a soft towel and using muffin tins for the parts is recommended.

1. Note all knob positions, preferably fully clockwise or counterclockwise, and then loosen setscrews and remove the knobs. The megacycle "lever" pulls off, since it has no setscrew.

2. Remove the screws for the bottom shell of the cabinet and remove the shell. Repeat for the top shell but be careful of the speaker leads. Disconnect the speaker leads on the circuit board (white lead goes to "SP" and black lead to "E").

3. Remove the rubber spacer pad from above the frequency display and the foam from above the tone squelch LED.

4. Remove the four screws around the perimeter of the front panel and, being careful not to scratch the plastic which will come loose from the frequency display window, remove the front panel.

5. Remove the six LED frequency display digits by unplugging them *in order;* they are *not* identical.

6. Unfasten the subassemblies for the tone squelch LED, the "on-air" LED, and the ±600 kHz offset LED, and store them out of the way.

7. Unfasten the dual pots used for the volume and squelch and store them out of the way.

8. Remove the four screws used to hold the PC board for the frequency display to the frame. Set it out of the way as best you can.

9. Depending upon your dexterity, approach the microphone connector from either above or below with the X-acto knife. Use the knife to cut the ground lead away from pin 4 and make sure there is no chance of it touching the other pins. Use a piece of small-gauge insulated wire and solder one end to pin 4. If your soldering iron is too large, wrap a length of bare 12-gauge wire around the tip and extend it out about one inch, parallel to the original tip. This will be a good "tip extension." Run the lead upward from the connector to the top side and route it along the left portion of the rig.

10. Locate a point labeled "T10" on the front edge of the TX unit board labeled X56-1230-10. Connect one end of a 1/4- or 1/2-Watt, 470-Ohm resistor to the point labeled T10 with a lead as short as possible. The resistor should rest against the metal shield with the other lead facing the left side of the cabinet.

11. Slide a piece of tubing about two inches long over the wire going to the microphone connector. The tubing should be large enough to fit over the resistor. Connect the other end of the wire to the resistor lead, keeping it as short as possible. After soldering the lead to the resistor, slide the tubing over the resistor.

12. Reassemble the cabinet and subassemblies in reverse order.

13. Modify the Kenwood microphone supplied with the rig and any other microphones you plan to use to ensure that they do not have a lead which grounds pin 4. This pin has the supply voltage for the tone encoder when the rig is in transmit. Although the 470-Ohm resistor will limit the current, this is undesirable and could cause problems. Use pin 3 for the shield and PTT grounds.

14. Adjust the encoder output level, if needed, which is done via a pot inside the Drake microphone.

Routing the coax to the roof can be done in more than one way—via door openings or around windows. But these methods are susceptible to water leaks, pinched cable, and untidy installation. Investigation showed that the mounting posts for the luggage rack were hollow. Hence, the coax was routed under the carpet and up the side pillar to the roof. A hole was drilled through the roof after removing the post for the luggage rack. An SO-239 fitting was mounted in the post, and this allowed easy attachment of coax for the magnetic-mount antenna. The fitting was of the type which uses two nuts on the shell to mount it in a single hole rather than the type needing four mounting screws. The connector and hole through the roof were sealed with silicone sealer to guard against water leakage and chafing of the cable. A plastic cap covers

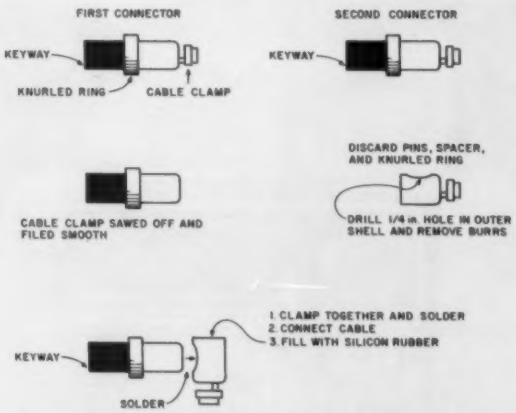


Fig. 3. Ensure that there is a cable sheath, or add spaghetti, where the wires pass through the soldered junction. This will prevent chafing.

the connector when it's not in use. I had to prune the coax to get the swr to an acceptable level. A large rubber boot for a battery clamp was used to protect the PL-259 against rain and snow.

In order to make the antenna more pleasant, if that can ever be done for an XYL, it was decided to cover the magnetic mount with plastic tape which roughly matched the color of the car. A coat of clear lacquer spray was applied over the tape. Magnets were taped to the coax to minimize its movement along the roof, which could scuff the paint. The XYL, being extremely considerate, agreed that the installation was perfectly acceptable—as long as the final approval could be handled over dinner at a nice restaurant.

As far as the problem of the mobile mount scratching the rails, cabinet, and heat sink, I could find no solution other than to put plastic tape on the cabinet. This is the only flaw I have found with the 7400,and it was quite unexpected considering my favorable experiences with my TS-520 and TS-820. Nobody said mobile was easy on equipment, so this is the price you pay. There are plans to house the fixed station power supply in a cabinet which will cover the 7400 in such a way as to hide the scratches.

I would appreciate hearing from others concerning their experiences with the 7400 and, more generally, with mobile operation to increase safety and ease of operation. This two meter installation is very enjoyable to use and is still very exciting, even for a seasoned ham.■

New Products

from page 49

as well as very high speed clock and control in computers and other equipments.

For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.*

SENCORE OFFERS EASY-TO-USE, INTERFERENCE-FREE 1 GHZ FREQUENCY COUNTER —MODEL FC51

A new, 1 GHz, all direct-reading push-button frequency counter has been introduced by Sencore for measurements in the newly authorized 806-947-MHz two-way communication business and police band. .5 parts-per-million accuracy also enables testing to FCC specifications in the 902-928-MHz medical electronics and industrial scientific band, the 470-806-MHz UHF TV band, and the 947-952-MHz oral broadcast band.

A 50-Ohm input is provided for communications measurements from 10 MHz to 1 GHz at an average sensitivity of 100 millivolts to assure a clean, interference-free signal pickup with either the supplied untuned pickup loop or the supplied adjustable antenna. An external, optional 30-dB wideband amplifier, Model WBA52, simply plugs into the 50-Ohm cable system to increase sensitivity to 5 millivolts for troubleshooting low-level stages, measuring any communication generator accuracy, or for remote transmitter documentation. The FC51 is powered by 115 volts ac or plugs into the 12-volt cigarette lighter of any vehicle for these remote checks.

An easy-to-use crystal check is included as an integral part of the frequency counter because crystals are the first suspect when measurements are not to FCC specifications. The FC51's highly-accurate 10-MHz crystal clock oscillator is also buffered and brought out the back to serve as a check against WWV or to calibrate less accurate frequency counters or other equipment. The clock oscillator is plugged in and removable for exchange with the factory Service Department for calibration purposes to assure no down time. The oscillator is also available for separate purchase. Price of the FC51 is $975.

Sencore, 3200 Sencore Drive, Sioux Falls SD 57107; (605)-339-0100.

THREE NEW OSCILLOSCOPES FROM HICKOK

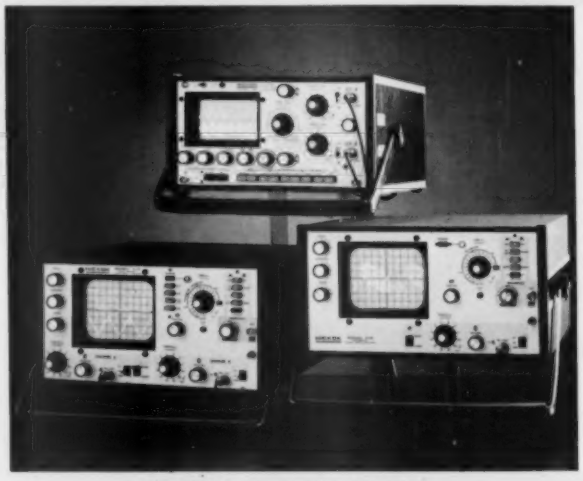
Quick and easy setup and operation are the key features in a new line of push-button triggered oscilloscopes being introduced by the Hickok Electrical Instrument Company. The line consists of three low-priced models, all of which feature automatic triggering, color-coded front panels, and conveniently grouped controls that speed up and simplify operation. All three models are aimed at industrial, commercial, and consumer service applications. The scopes are also suitable for cost-conscious production testing applications which usually do not require extremely wide bandwidths.

The Model 532 at $995 (including probes) is a dual-trace 30-MHz scope with 11.7 ns rise time and a built-in delay line for leading edge viewing of fast rise time pulses. Among its many features is a full-time 4x expansion that allows any portion of a pulse train up to 40 full divisions long to be viewed without the use of a multiplier. Well suited for logic and pulse circuit applications, it is capable of testing most digital logic circuits—including microprocessors.

The Model 517 is a dual trace 15-MHz scope with 5 mV/cm sensitivity and reliable trigger-

Continued on page 63

Sencore's FC51 1 GHz counter.



Hickok's new oscilloscope line.

This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built in balun. Up to 300 watts RF output. Matches everything from 1.8 thru 30 MHz: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balanced lines, coax lines.

BRAND NEW

NEW, IMPROVED MFJ-941B HAS . . .
- More inductance for wider matching range
- More flexible antenna switch
- More sensitive meter for SWR measurements down to 5 watts output

$89.95

Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941B Versa Tuner II with all these features at this price:

A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax lines direct or thru tuner, random wire/balanced line, and tuner bypass for dummy load.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balanced lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balanced line, or random wire.

ANTENNA SWITCH lets you select 2 coax lines direct or thru tuner, wire/balanced line, dummy load.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 8x2x6 inches fits easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balanced line inputs (2), random wire input (1), and ground (1).

NEW 300 WATT MFJ VERSA TUNER II'S: SELECT FEATURES YOU NEED.

NEW MFJ-945 HAS SWR AND DUAL RANGE WATTMETER.

$79.95 BRAND NEW

Same as MFJ-941B but less 6 position antenna switch.

NEW MFJ-944 HAS 6 POSITION ANTENNA SWITCH ON FRONT PANEL.

$79.95 BRAND NEW

Same as MFJ-941B but less SWR/Wattmeter.

NEW MFJ-943 MATCHES ALMOST ANYTHING FROM 1.8 THRU 30 MHz.

$69.95 BRAND NEW

Same as MFJ-941B, less SWR/Wattmeter, antenna switch, mounting bracket. 7x2x6 in.

ULTRA COMPACT 200 WATT VERSA TUNERS FOR ALL YOUR NEEDS.

MFJ-901 VERSA TUNER MATCHES ANYTHING, 1.8 THRU 30 MHz.

$59.95 BRAND NEW

Efficient 12 position air inductor for more watts out. Matches dipoles, vees, random wires, verticals, mobile whips, beams, balanced lines, coax. 200 watts RF, 1:4 balun, 5x2x6 in.

MFJ-900 ECONO TUNER MATCHES COAX LINES/RANDOM WIRES.

$49.95 BRAND NEW

Same as MFJ-901 but less balun for balanced lines. Tunes coax lines and random lines.

MFJ-16010 RANDOM WIRE TUNER FOR LONG WIRES.

$39.95

1.8 thru 30 MHz. Up to 200 watts RF output. Matches high and low impedances. 12 position inductor. SO-239 connectors. 2x3x4 inches. Matches 25 to 200 ohms at 1.8 MHz. Does not tune coax lines.

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Radcliff KY 40160

Be A Surplus Survivor

—don't get burned by a boat anchor

After you have that new Novice ticket, you have to think about getting on the air. Having seen the prices of some of the new solid state equipment, I am going to offer another possible route for getting started. There are many inexpensive allband rigs available at a reasonable price in the surplus market. In addition to being in some cases very inexpensive, the surplus gear also offers the new Novice a chance for actual hands-on experience.

When I was first licensed as a Novice in 1958 as KNØGHF, my first transmitter was built from parts of an old discarded television receiver. It consisted of a 6AQ5 oscillator, a 6AQ5 buffer, and a 6AQ5 final running a whopping ten Watts. Later, I acquired an 807 and modified the final and the power supply to meet the voltage requirement. My receiver was a surplus ARC-5 for the forty meter band, to which I added a volume control, an on-off switch, and a bfo on-off switch. I had the receiver B+ dropped down from the transmitter supply, controlled through a relay.

I will never forget the thrill of my first Novice QSO. At that time, I was stationed near a small town in mid-Missouri, and my first contact was a ham in eastern Virginia. I think the biggest thrill was having the satisfaction of seeing the home-brew transmitter putting out a good clean signal.

But enough of the past. Let's take a look at what is available in the surplus market today. The most popular, and the most converted, is the old ARC-5 equipment. There have been numerous articles written in amateur radio publications, so I will not go into any elaborate conversions. The ARC-5 sets are still available from surplus dealers at a price range of $18 to $20 for the receivers and $14 to $16 for the transmitters. An added extra is the use of an ARC-5 for the station vfo, and the low-frequency receivers can be modified into Q-5ers.

Another old favorite was the Navy TCS series of receivers and transmitters. Quite a few conversions have been written on both sections of this old set, both separately and as a complete station. A unit currently being advertised by Fair Radio Sales Company which shows promise for the more advanced builder/conversionist or experimenter is the RT-380/AR or the old Collins Model 18S4 transceiver.

I would like to point out one thing to beware of in selecting a piece of surplus equipment. Unless one has access to a 400-cycle power source, do not consider any of the autotune units without being prepared to perform some extensive modifications. Otherwise, the only thing to remember is that almost all of the military equipment was designed to operate from a 24-volt dc source, and, in many cases, the high voltage supply was a separate unit. With a

Bary Electronics Corp. 512 Broadway New York NY 10012	1, 2
Fair Radio Sales Co., Inc. PO Box 1105 Lima OH 45802	1, 2, 3
Edlie Electronics, Inc. 2700 Hempstead Turnpike Levittown NY 11756	1, 2, 3
Slep Electronics Co. PO Box 100 Otto NC 28763	1
Selectronics 1206 Napa Street Philadelphia PA	1, 2
Gadgeteers Surplus Electronics, Inc. 5300 Vine Street Cincinnati OH 45217	1, 2
G & G Radio Supply Company 75-77 Leonard Street New York NY 10013	1, 2
Columbia Electronics Sales 4365 West Pico Blvd. Los Angeles CA	1, 2
Arrow Sales-Chicago, Inc. 2534 South Michigan Avenue Chicago IL 60616	1, 2

Table 1. Surplus dealers. Notes: 1—equipment; 2—parts and components; 3—manuals and schematics.

few exceptions, the tube lineup consisted of a number of twelve-volt tubes in a series-parallel arrangement. A study of the set diagram will reveal whether or not six-volt tubes may be substituted and the heater string run from twelve volts. The plate, screen, and bias supply can be built from a discarded TV set. I have found many a discarded TV set which contained a good husky power transformer, as well as a choke and some tubes. It should be noticed that the TV power transformer was designed to furnish filament voltage for ten to fifteen tubes plus the high voltage for the various tubes.

When converting surplus equipment, it is always advisable to obtain and study thoroughly the schematic diagram. In this way, a better understanding of what is being done in the conversion is acquired. Although many of the original manuals have long been out of print, schematic diagrams of most of the useful sets are available from *CQ Magazine* as well as Editors and Engineers (Howard Sams and Co., Inc., Indianapolis IN). Back issues of *CQ, 73,* and *QST* also have many schematics as well as conversion articles on just about anything worthy of conversion. A list of some of the surplus dealers as well as sources for technical manuals is included in Table 1 for your information. I will also make my library available for those who run into difficulty or need information. Please include a self-addressed stamped envelope with your request. Happy hamming. ■

New Products

from page 60

ing up to 30 MHz. Priced at $695 (including probes), the Model 517 features automatic selection of chopped or alternate operation in dual-trace mode depending on sweep speed selected. Complete with algebraic sum and difference capability as well as TV line and frame sync circuits, the Model 517 is ideal for TV, VCR, audio, and video maintenance and repair as well as design and troubleshooting of most digital logic circuits.

The Model 515 offers most of the features of the Model 517 in a lower-priced ($495 including probe), single-trace version well suited to industrial and consumer servicing as well as laboratory and educational applications. TV sync separators are built in for easy locking to complex TV video waveforms at any sweep speed and, like the Model 517, it provides x-y operation for vectorscope measurements.

Engineered and designed for fast, reliable operation with minimal training or familiarization, the new line of Hickok scopes is currently in stock at Hickok distributors throughout the country.

The Hickok Electrical Instrument Company, 10514 Dupont Ave., Cleveland OH 44108; (216)-541-8060.

Triplett's Model 3300 DVOM.

NEW MODEL 3300 HAND-SIZE 3½ DIGIT DVOM FROM TRIPLETT HAS BETTER READABILITY, ACCURACY, AND BATTERY LIFE

The new 3½ digit Model 3300 digital VOM just introduced by the Triplett Corporation features an easily read .3" high digit LED readout display with polarity indication, .5% accuracy, and low power-Ohms. The five-function, 22-range Model 3300 offers complete portability with precision measurement capability, and sells for only $175, complete with long-life nicad batteries and ac adapter/charger plus test probes with safety boots.

It is only 3" wide by 5-3/8" long by 1-3/8" deep. Ideal for test bench or field use, for circuit testing, design work, production line checks, industrial maintenance, and general-purpose applications.

A snap-in Battery-Pac™ with the nicad batteries and ac adapter/charger recharges separately or within the tester.

The Triplett Model 3300 is a safety-conscious design with no exposed metal parts and it includes a high energy 2 A, 600 V fuse for ample overload protection. A fused probe provides for both high-energy and normal-use circuit protection. The molded gray high impact thermoplastic case with a non-slip finger tread finish offers structural strength, light weight, and professional instrumentation styling.

Overrange is indicated by a blinking display and a low-battery warning is included. Dc polarity is automatic with indication directly on the readout display.

Single-selector switch ranges include: .2-600 V dc; .2-600 V ac (60 Hz) with 10 megohm/100 picofarad input impedance on all ac ranges; Low-Power (200 mV FS) 0-2 megohms with zero adjust for lead resistance; Hi-Power (2 V FS) 0-20 megohms; ac and dc milliammeter reads 0-200 mA. Typical dc accuracy is .5% of reading.

Full details on the new Model 3300 DVOM and its complete line of accessories may be obtained by contacting *Triplett Corporation, Bluffton OH 45817; (419)-358-5015.*

NEW MOBILE DISGUISE ANTENNAS AVAILABLE FROM ANTENNA INCORPORATED

Antenna Incorporated has introduced a new line of Mobile Disguise Antennas that are visually indistinguishable from standard broadcast antennas. These antennas are for the growing land mobile two-way business radio market.

The Mobile Disguise Antennas are available in two mounting configurations: Ford style or standard universal cowl mount, for either the single band or combination AM/FM land mobile models. A special matching harness is included with either model.

Offered in three frequency ranges, 25-54 MHz, 130-174 MHz, and 406-512 MHz, the Disguise Antennas are factory tuned to the frequency the customer specifies. Maximum power is over 150 Watts for the single-band model, or 100 Watts for the combination AM/FM land mobile model. The radiation pattern is essentially omnidirectional, dependent on

Continued on page 71

Tracking the Wild Turkey

—DF tips

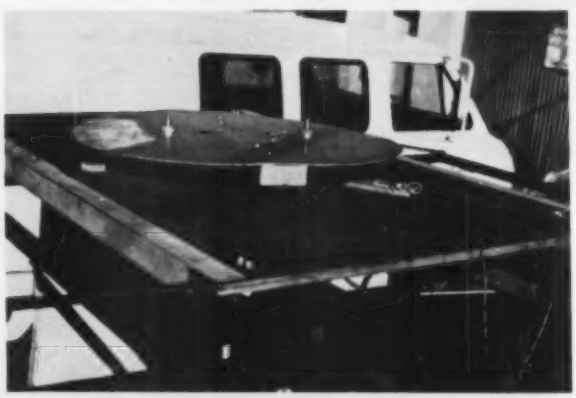
Mike Naruta WA8BHR
4466 Burtch Rd.
North Street MI 48049

How would you like to find that repeater jammer? Maybe you're in a small boat. The compass tells you in which direction you are pointing, but not your location. Perhaps you want to reject stations from one direction and listen to another direction. Or maybe you just want to know if that transmitter is really where he says he is. How do you do it?

Well, the simplest type of directional system is using a directional antenna. The half-wave dipole antenna has rather broad peaks. See Fig. 1. The secret in using directional antennas for direction-finding is not using the peak response, but rather the nulls. It is much easier to hear the difference between a small signal and no signal than it is between a large signal and a larger signal.

A better antenna would be the common "loop" antenna. If the circumference of the loop is about one wavelength, the pattern is similar to the dipole: The peaks are perpendicular to the plane of the loop. If the loop is a small part of a wavelength, the pattern changes: The loop's strongest reception is in the direction of the plane of the loop. See Fig. 2. This occurs because the antenna operates on the difference in strengths between one side of the loop and the other.

The loop antenna can be improved with the addition of a ferrite core, as is used in the common pocket transistor radio. The basic broadcast transistor radio is a very sensitive direction-finding device. At one New Year's Eve party, my friends had a transmitter hunt using pocket BC radios. The technician of the group had built a very small oscillator, less than half a cubic inch. We took



Why not try out this strange-looking direction-finding device?

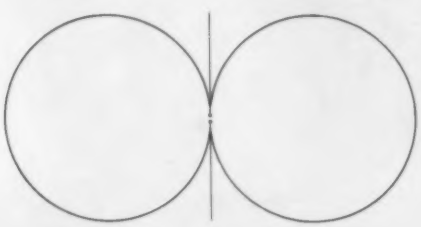


Fig. 1.

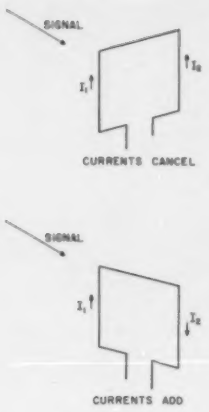


Fig. 2.

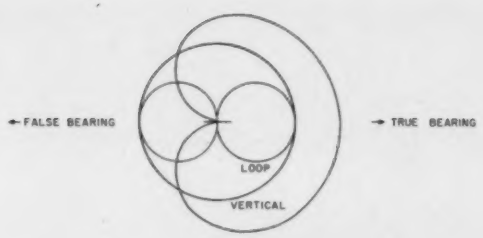


Fig. 3.

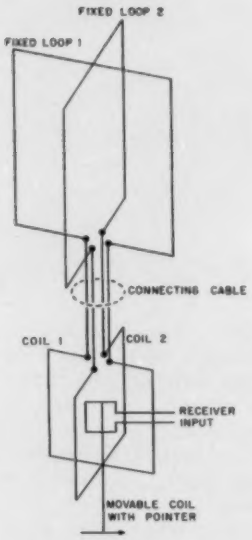


Fig. 4.

turns hiding the oscillator and tracking it down with the radios. It didn't take long to find the oscillator in the most unlikely places, and it was great fun.

Many years ago, some guy didn't like turning the loop around constantly, so he figured out a way to motorize it. By taking the output of the receiver, amplifying it, and feeding it to a motor connected to the loop, the loop would keep turning until the signal dropped off, at the null. If you added some kind of position-indicating device to the antenna, such as a senslyn, the antenna could be quite a distance from the operator.

There is a problem with this system. The loop antenna is bidirectional, a figure eight pattern. That means there are two peaks and two nulls which it can lock onto. However, by adding another antenna, a vertical this time, and combining the signals properly, a cardioid pattern with one sharp null is produced. See Fig. 3. Now our system automatically points in the proper direction and indicates where the station is. Indeed, ADF (Automatic Direction-Finding) or "Radio Compass" has been used on aircraft and ships for many years.

If you don't want a loop antenna spinning around outside the aircraft, the loop can be brought inside and fooled into thinking it is still outside. A goniometer is a set of fixed loops that receives the signal and brings it inside the instrument. Inside, another loop responds just as if it were outside. See Fig. 4. The instrument and leads must be well shielded. Just attach a pointer to the movable coil and you have only one moving element. Used primarily for 90 to 1800 kHz, it provides a good system for indicating the direction of a station. You can fly "to" a station or "away from" a station. To find your position, or the position of a transmitter, you need another "fix." See Fig. 5.

Another aircraft navigation system is VOR. It stands for VHF Omni Range and is transmitted from 108 to 118 MHz. To get an idea of how VOR works, try visualizing a lighthouse. Picture the beam as it sweeps around. Imagine that whenever the light beam points exactly north, the lighthouse sounds its foghorn. If you were on a boat, and you knew the time it took the beam to go around completely, you could determine which direction you were from the lighthouse just by waiting until the foghorn sounded and counting the time until you saw the flash of the light. See Fig. 6. This is just how it works in VOR. The signal is transmitted as if it were rotating very fast. An omnidirectional pulse is transmitted when the beam is pointing north. A VOR navigation receiver times the interval between the sync pulse and the reception of the "searchlight" beam. This system tells the pilot which "radial" he is on. Note the difference between ADF and VOR: ADF tells the pilot which direction the station is with respect to his craft. VOR tells the pilot which direction he is with respect to the station.

Another method of finding yourself is loran. If we know that two stations transmit a pulse at the same time, we can time the difference between their arrival times at our location, thereby learning our relative position between the two stations. If we receive the pulses from the two stations at exactly the same time, we know that we are equally distant from both stations. See Fig. 7, ship X. If we find station A's pulse arriving before station B's, we know that we're somewhere between the centerline and station A. See Fig. 7, ship Y. By using at least three loran stations (see Fig. 8), we can find our position. Like VOR, loran tells us our position, but not what direction we are facing. Loran operates on four frequencies, 1750, 1850, 1900, and 1950 kHz, with 40-microsecond pulses occurring about 25 times each second. It's quite a racket, as anyone who has listened to the 160 meter band can tell you.

Somewhat similar to loran is the omega system. Orginally designed as an ocean locating system, omega uses the VLF band (10 to 14 kHz). With only eight stations and the advantage of VLF, it covers the world. Using a nice, long wavelength, omega devices analyze the phase difference of signals being received.

The military uses "stationary" satellites for a high band position-finding system. The receiver is very accurate. You can march around the world with a little box on your back, always knowing exactly where you are.

If you would like to experiment with direction-finding, try out a loop antenna. They are not hard to make. Just make sure that with a shielded loop, you don't close the shielding entirely; leave a small gap at the top or you won't hear anything. A shielded loop reduces electrostatic noise and increases accuracy. When using the loop for receiving, you may find it more convenient to tune the null to reduce QRM from another station, rather than try to peak on the desired station.

On VHF you might want to try a quad antenna. I

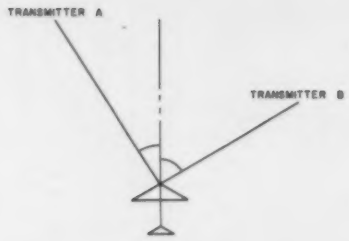


Fig. 5.

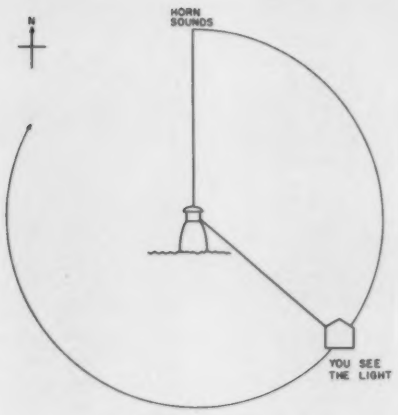


Fig. 6.

saw a folding quad for 2 meter T-hunts made from a TV antenna. The foldout elements are used for horizontal spreaders, with fixed vertical spreaders fitted into holes drilled in the boom.

For transmitter hunts, the loop is pretty slow. If you are trying to locate a repeater kerchunker, in the second or two it takes you to rotate the loop, he is gone. While working at a business radio shop in California, they were having trouble with their radios disappearing from customers' vehicles. After the theft, the customers would be hit with all sorts of jamming. The solution was the strange-looking device shown in the photo. The big circular plate is aluminum. Two quarter-wave vertical antennas are exactly 1/2 of a wavelength apart. This gives a figure eight with sharp nulls. To catch the short transmissions, the disk is spun about three times a second by an electric motor on the frame below. The feedline from the antenna array runs down a water pipe shaft, terminating in a BNC connector, but the outer shell is not tightened, providing an excellent rotating contact.

At the edge of the disk is a block with a small magnet. On the plywood base under the path of the magnet is a reed relay. When the magnet passes the reed relay, it closes to give a reference pulse indicating that the antenna is pointing straight ahead. Now the clever part. Using an oscilloscope, the vertical input is connected to the receiver audio, and the horizontal sweep is triggered by the reed relay. When you hear the signal, the null is a dip in the trace. If the null occurs right at the start of the trace, you know the source is directly ahead. If the null is one quarter of the horizontal distance across the trace, the transmitter is to the right or left of you. Since the array is revolving so fast, it only takes a fraction of a second to get a bearing. In the time it takes to key up the repeater, you can get a fix on the transmitter. (Don't forget build it yourself, manufacturers offer ready-built direction-finders. L-Tronics of Santa Barbara CA has several models, starting in the $135 price class.

There are other forms of direction-finding and position-locating. Remember, direction-finding usually depends on some type of antenna array. Position location can use direction-finding techniques, but often examines some characteristic of transmitted

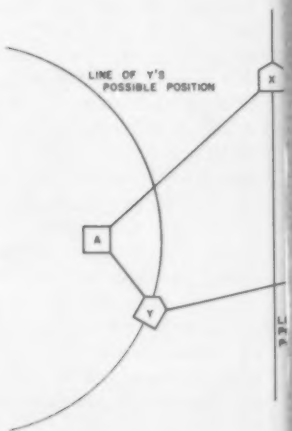


Fig.

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High Q Antennas

—*stop worrying about swr*

When a friend of mine once proudly told me that his ordinary eighty meter dipole had a band-edge swr of about 1.8:1, instead of congratulating him, I said, "Oh, isn't that too bad." Well, he almost flipped. But after we started to talk a bit about antenna losses, his pride turned to consternation. Actually, his antenna was an inverted V, quite low, with the ends about seven feet from the ground. There were enough trees and bushes nearby to provide losses. And, in addition, the ground was sandy, so there were losses from that, too.

When the same antenna was later relocated with a better overall height, without nearby trees and bushes, sure, his swr went up, but so did the overall antenna performance.

Although I am in favor of special antennas, such as the parallel stub double bazooka, discones, bow ties, and others that can lower swr because of their basic broadband characteristics, I am concerned at low swr in an ordinary dipole. It generally means high losses. So take a good look at lossy objects near your antenna that might be causing problems. Although any object near an antenna can induce both resistive losses and a change in the antenna reactance and Q, to simplify thinking, I will disregard such changes in reactance for two reasons. First, a change in antenna reactance is not a power loss, and, second, it would be almost impossible to predict such reactance changes in an amateur antenna system.

And that is why I thought it would be both interesting and useful to expand some basic antenna theory into a presentation that will relate antenna resistance, Q, and swr. The graphical presentation allows for easy understanding without having to delve through pages and pages of complicated mathematics that too often obscure what one is really trying to say. Radio amateurs come from all walks of life, and the high mathematics of the specialist can and always should be boiled down to a level where they are easily understood by all of us.

Now that I've decried high math, and also to prove my point, I'll show how simple, easily understood and explained calculations will be used for those who want to do a bit of figuring on their own. Specific calculations will be shown for those who have rf bridges and would like to translate their measurements into useful information. My calculations will show rf bridge measurements can easily be translated into swr and Q. And, by showing how the curves were derived, you should understand them a bit better.

Conditions and Stipulations

In order to keep the basic math and concepts as simple as possible and yet not lose the overall concept of the presentation, the following conditions and stipulations are made.

1. A basic eighty meter dipole, resonant at 3.75 MHz, will be used as reference. Its characteristics will be described as a simple series circuit with R being the antenna resistance at resonance. The antenna inductive reactance will be shown as X_1, and the capacitive reactance will be shown as X_C.

2. It will be assumed that the antenna resonant resistance will stay the same over the entire band. It does vary to some degree, but this assumption is quite common in simplified antenna analysis.

3. The swr values will be shown for the band-end condition of 3.5 MHz. The values of swr at 4.0 MHz, if calculated, would be found to be slightly lower, but this in no way invalidates the aim of understanding concepts.

4. Q is designated as antenna inductive reactance divided by antenna resistance at the resonant frequency, which, as I said, was chosen to be 3.75 MHz.

5. A feedline impedance of fifty Ohms will be used for

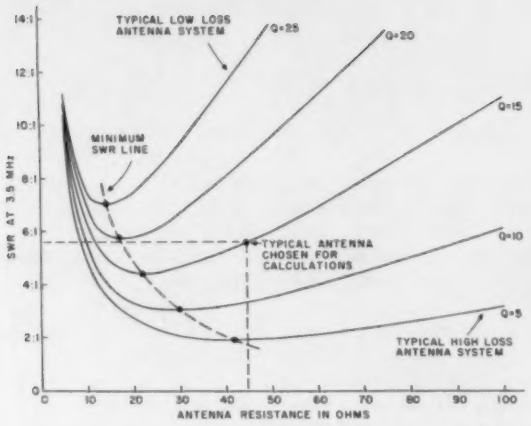

Fig. 1.

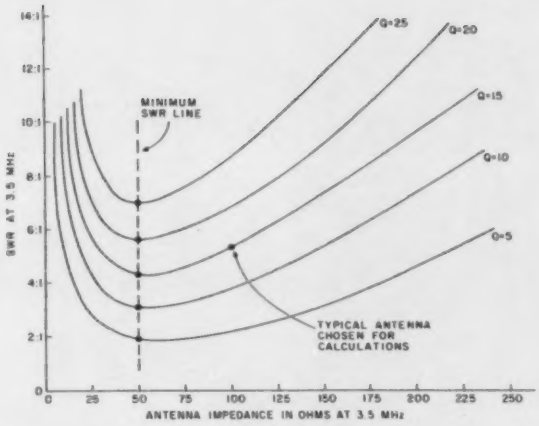

Fig. 2.

the Q curves, Q equals 5 to Q equals 25, shown. Fifty Ohms was chosen, as that is the value of feedline impedance used by most amateurs. However, an additional curve will be shown for a specific stipulated antenna to show how swr can vary with feedline impedance for a given aerial. The specific antenna will be the same as the one chosen for the calculations, namely one of 44 Ohms resistance with a Q of 15, which means an antenna with a resistance of 44 Ohms and a capacitive reactance of 91 Ohms at 3.5 MHz. By using a specific antenna with numerical values, it will be very simple to show how rf bridge antenna measurements can be translated into swr and Q later on.

Losses and Swr

If you could conveniently neglect antenna losses, you would realize that a low swr antenna has several advantages. Low swr means that the loss in your feedline is a bit less for the same power transmitted at a high swr. Low antenna swr also means that it is much easier to match your transmitter which is designed for a 50-Ohm load into your 50-Ohm antenna feed system. And, if your transmitter does not have good matching capability at high swr loads, this can mean, in some cases, lowered equipment efficiency. And, also, a high swr can cause excessive voltages and currents to be developed in your transmitter. So low swr does have advantages. But, if your low swr is obtained by a lossy antenna system, you haven't gained anything. You are actually losing some of your power to trees, bushes, roofs, or what have you. So low swr isn't always the blessing you might have thought it to be.

You know that Q in a tuned series circuit is both a figure of merit and also a function of selectivity. Also, briefly, the lower the Q, the less the selectivity. If you think of the Q of an antenna circuit, you realize that the antenna resistance is not just a loss resistance. The antenna resistance is made up of two components: a radiation resistance, which is desirable, and a loss resistance, which is undesirable. Like a tuned circuit, the lower the resistance, the higher the Q, and the higher the Q, the higher the selectivity. High selectivity means a high swr. So basically, the higher the Q, the higher the swr. And, all things being equal, the higher the Q, the less your losses, and the more efficient your antenna is. Antenna losses from outside sources are coupled into your antenna just like the resistance that can be coupled into a tuned circuit. Although complicated engineering measurements and calculations can be used to differentiate between useful radiation resistance and useless loss resistance, such an analysis is far beyond the scope of this article. To emphasize the desirability of keeping losses down, don't worry about a high swr. It means that, if your antenna resonates properly at your center frequency, your band-end swr just shouldn't worry you. But if it's low, you had better start looking at what the causes are.

The Graphs

And now to look at what the curves tell. Fig. 1 is a plot of antenna resistance versus swr for five different values of Q. The curves are shown for the band end of 3.5 MHz. One thing is immediately apparent – the lower the Q, the lower the swr, and the higher the antenna losses. You also see that, for a specific value of antenna Q, there is one value of antenna resistance that gives the lowest possible value of swr. And you also see that two different antennas both having the same value of Q can have differing values of swr. To show this point, I'll pick off some values from the Q-equals-15 curve. At an antenna resistance of 44 Ohms, you have an swr of 5.6:1. But, if the antenna resistance drops to 21.75 Ohms, the swr drops to 4.38:1. If the antenna resistance was to drop even lower, the swr would increase.

Although the factors of Q and antenna resistance are not readily controllable in an ordinary dipole antenna, it clearly shows that differing antenna systems can show differing values of swr. In addition, you know that antenna resistance among other things is dependent upon height. This is why it is impossible to make any broad generalizations about swr. That's all the more reason it should be more thoroughly understood.

On Fig. 1, you can, as a matter of interest, connect the points of minimum swr for the various Q curves and see how minimum swr relates to Q and antenna resistance. As a further interesting item, I'll say now and later show that, at all of these points of minimum swr, the antenna impedance at the band end of 3.5 MHz is fifty Ohms. And this value of impedance is the same numerical value of the feedline which I had established as fifty Ohms as the reference. But it is very necessary to say numerical value, as the antenna impedance, as you shall see, is a complex quantity made of resistance and reactance. It is only at the resonant frequency that the antenna ever looks like a pure resistance.

If, for example, you took

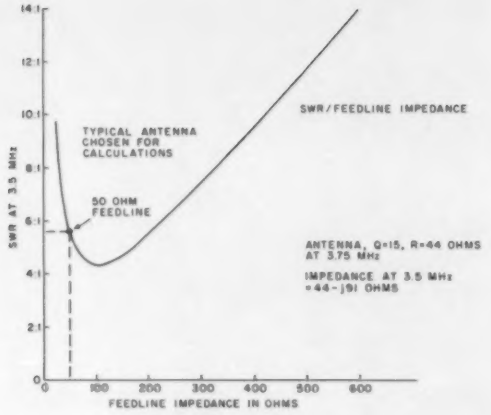
SWR/FEEDLINE IMPEDANCE
TYPICAL ANTENNA CHOSEN FOR CALCULATIONS
50 OHM FEEDLINE
ANTENNA, Q=15, R=44 OHMS AT 3.75 MHz
IMPEDANCE AT 3.5 MHz =44-j91 OHMS
SWR AT 3.5 MHz
FEEDLINE IMPEDANCE IN OHMS

Fig. 3.

the point of minimum swr on the Q-equals-15 curve and measured the impedance at 3.5 MHz, you would find it to be equal to R equals 21.75 Ohms and X equals 45.1 Ohms capacitive reactance. The absolute value of the impedance Z equals:

$$\sqrt{R^2 + X^2} \text{ equals}$$
$$\sqrt{21.75^2 + 45.1^2}$$

equals 50 Ohms impedance. And you would find that the swr at this impedance would be 4.38:1. To show this relationship even more clearly, Table 1 indicates all of the relevant data for different values of Q. Fig. 2 shows a plot of antenna impedance Z versus swr for the Q curves.

The curves of Fig. 2 and the data of Table 1 tell that, even though the impedance is fifty Ohms for the minimum value of swr, you have to think about the resistance and reactance values rather than just the impedance Z. At the low swr, low Q, the antenna has a predominantly resistive component. At the high Q-curve, the antenna is predominantly reactive. It also tells that, if you want to make any meaningful antenna measurements, you will need a bridge that can measure both R and X. A bridge that will only measure the absolute quantity Z can very easily lead to erroneous conclusions. But simple rf bridges to measure R and X can be easily built or obtained commercially. There is nothing more conducive to learning about antennas than making your own measurements and calculations and analyzing the results.

Conclusions

The curves themselves show the various interrelationships between Q, swr, and antenna resistance along with the concept of a minimum swr. It is now clear that a low swr on an ordinary dipole means a lossy antenna system, and also that a low swr is really not something to be proud of. A high-Q antenna would be far more praiseworthy. Get off the low swr kick, and think about high Q and antenna efficiency. You'll find it pays off. High swr can be handled by means of a simple antenna coupler or matchbox, if your transmitter doesn't load out properly without one. Or, as I mentioned, specialized antennas designed to give broadband performance, such as the parallel stub double bazooka (August, 1977, *73 Magazine*), the discone, or the bow tie, can be utilized. The curve of Fig. 3 is important in that it shows the relationship of swr to feedline impedance for a specific antenna. The antenna values chosen are 44 Ohms resistance and a Q of 15. This means a band-end impedance of 44 Ohms resistance and 91 Ohms capacitive reactance at 3.5 MHz. You see that, at a feedline impedance of fifty Ohms, the swr is 5.6:1. But, if a feedline impedance of 600 Ohms is used, the swr goes up to 13.95:1. And yet the antenna is the same in both cases. This shows one other variable that can affect your swr value.

It is hoped that these observations will lead to a better understanding of why a dipole often acts as it does and also that they will encourage the experimentation that is really a fun thing in our fascinating hobby of amateur radio.

R	X	Q	swr	Z
10	48.99	35.47	9.90	50
15	47.70	23.03	6.51	50
20	45.825	16.59	4.79	50
25	43.3	12.54	3.73	50
30	40	9.65	3.00	50
35	35.71	7.38	2.45	50
40	30	5.43	2.00	50
45	21.79	3.50	1.60	50

Table 1. This table shows minimum swr values of different antennas of varying Q at the band edge of 3.5 MHz. It indicates how widely the values of X and R can vary, even though the impedance looking into the feedline antenna system is 50 Ohms (complex impedance) in each case.

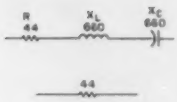

Fig. 4.

Calculations

Let's first draw a simple dipole antenna at resonance at 3.75 MHz and represent it as the series circuit of Fig. 4. If you assume a resistance of 44 Ohms and a Q of 15, it is easy to calculate the inductive and capacitive reactance in Ohms: $X_L = X_C = Q \cdot R = (15)(44) = 660$ Ohms.

Now, if you tune the antenna to 3.5 MHz, the inductive reactance will decrease to: $X_L = (660)(3.5 \text{ MHz}/3.75 \text{ MHz}) = 616$ Ohms.

And the capacitive reactance will increase to: $X_C = (660)(3.75 \text{ MHz}/3.5 \text{ MHz}) = 707$ Ohms.

And the difference equals: 707 - 616 = 91 Ohms capacitive reactance.

So the antenna at 3.5 MHz will look like Fig. 5.

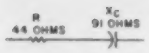

Fig. 5.

The absolute value of antenna impedance will be equal to Z:

$$Z = \sqrt{R^2 + X^2} = \sqrt{44^2 + 91^2}$$
$$= 101 \text{ Ohms.}$$

The swr is calculated from the basic equation: $\text{swr} = (|Z_a + Z_c| + |Z_a - Z_c|) / (|Z_a + Z_c| - |Z_a - Z_c|)$, where Z_a is the antenna impedance and Z_c is the feedline impedance. The notation $|\ |$ actually means $\sqrt{R^2 + X^2}$ as you shall see when you put actual numerical figures in. The specific value of antenna impedance will be: $Z_a = 44_R$ and 91_X. I have identified the four parts of the swr equation as (1), (2), (3), and (4), as follows, to make the calculations easy: (1) $|Z_a + Z_c|$; (2) $|Z_a - Z_c|$; (3) $|Z_a + Z_c|$; and (4) $|Z_a - Z_c|$. So (1) equals $Z_a + Z_c$, and Z_c, the feedline, is 50_R. (1) of the swr equation $= |44_R - 91_X + 50_R| = |94_R - 91_X|$. This equals

$$\sqrt{94^2 + 91^2} = 130.8.$$

And, also, (1) equals (3).

Now, if you put in figures for items (2) and (4) of the swr equation, you see that (2) = (4) = $|Z_a - Z_c| = |(44_R - 91_X) - 50_R| = |-6_R - 91_X|$. Evaluating, you see that this equals $\sqrt{6^2 + 91^2}$, which equals 91.2 = (2) = (4).

Now, putting (1), (2), (3), and (4) in the swr equation together, you see that swr = [(1) + (2)]/[(3) - (4)] = (130.8 + 91.2)/(130.8 - 91.2) = 222/39.6 = swr = 5.6 at 3.5 MHz.

So you see that it really isn't difficult to calculate swr if you know the resistance

and reactance of your antenna at 3.5 MHz and know what your feedline impedance is.

The only remaining thing to do is to show how you can calculate the antenna Q. To simplify things, you will have supposedly measured the antenna resistance as 44 Ohms and its reactance as 91 Ohms at 3.5 MHz. By means of the easily derived equation below, you can, with this information, determine the reactance of the antenna at resonance. The equation is as follows: X_1 at 3.75 MHz = [($X_{3.5}$) (3.5 MHz) (3.75 MHz)] / [(3.75 MHz + 3.5 MHz) (3.75 MHz - 3.5 MHz)].

So X_1 at resonance = (91) (3.5) (3.75) / (7.25) (.25) = 660 Ohms.

Knowing that, $Q = X_1/R$ = 660/44 = 15 = antenna Q.

So you see that, with the information given, it will be readily simple to calculate swr and antenna Q if you know the measured values of R and X.

This article has not taken into account line losses, as this would perhaps complicate the general approach desired. But briefly, line losses will decrease both swr and Q values calculated. It is realized that some of the calculations can be done by means of Smith charts. However, as simple hand calculators are almost in common use by all amateurs, I felt that the approach used here would show how to actually do calculations, instead of teaching the specialized approach of the Smith charts. And, lastly, very few amateurs actually have Smith charts in their possession. As the calculations are of value only to those amateurs who have rf bridges, I felt that the general approach would give the most information to most amateurs reading this article. Math is only essential for those who actually are going to use it. It is not necessary to understand general principles. ■

New Products

from page 63

vehicle and mounting location. VSWR is 1.5:1 or less.

The antennas feature 32" whips made of permanent set, impact resistant 17-7PH stainless steel. High-quality 17' coaxial cables with matching transformers and PL-259 connectors are used to ensure dependable performance. All antenna connections are solderless. In-line cable connectors are provided on AM/FM models for easier installation and routing through openings as small as 3/8".

For further information on the new Mobile Disguise Antennas for land mobile applications, contact *Antenna Incorporated, 26301 Richmond Road, Cleveland OH 44146; (216)-464-7075.*

INTEGRATED CW MESSAGE MEMORY MATCHES 8043/4 KEYERS

A one-chip message memory control IC has been introduced by Curtis Electro Devices. Called the 8047, this 28-pin CMOS device requires only a 2102 (1K x 1 RAM) or equivalent memory IC plus an 8043/8044 or equivalent keyer to provide a program set of four 32-character CW messages. Features include variable pause repeat and automatic "end-of-message" reset.

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For additional information, contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040; (415)-964-3136.*

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Staco, Incorporated, of Dayton, Ohio, a manufacturer of variable ac voltage controls and dc power supplies for mobile electronic equipment, announces the introduction of a new budget-priced filtered power supply.

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The Model FPS-4 operates on a 120 volt ac, 60 Hz input, and provides 12-volt dc output at 5.5 Amps surge, 4 Amp continuous duty.

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VIZ Test Instruments Group of VIZ Mfg. Co. has added a new high-quality, moderately-priced VOM to its line of electronic test instruments.

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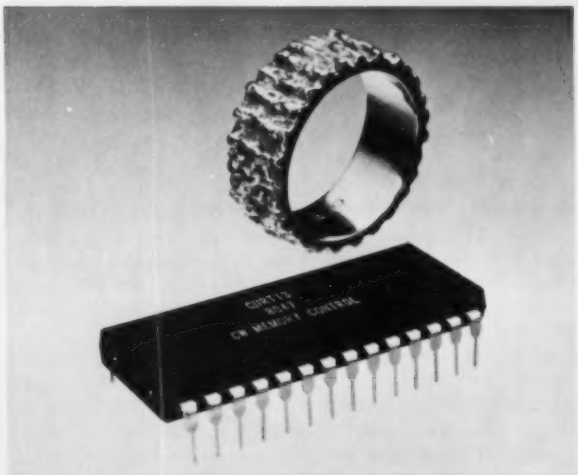
Continued on page 73



The Curtis 8047 CW message memory.

Staco's FPS-4 power supply.

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—adding TT convenience to your HT-144B

After being bitten by the 2m FM bug, I decided the only antidote was to go as inexpensively as possible on the 2m band.

I purchased an HT-144B from VHF Engineering and spent one weekend assembling the kit. The instructions were very explicit and clear. Except for one error (cockpit trouble), the unit performed very well.

Then, of course, the inevitable followed: I *had* to have a telephone touchtone™ pad. After considering a number of possibilities, I finally settled on a unit from Data Signal. The unit was their SME style "C" model with 12 characters.

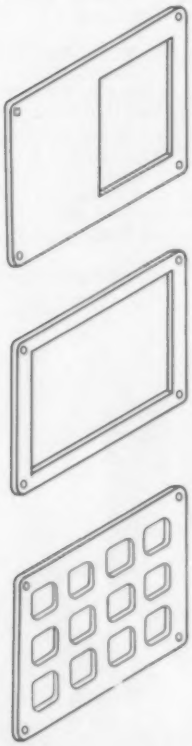

Fig. 1. Exploded view of bezel assembly.

This unit uses a tactile plastic pad and is very thin. (In fact, it looked so fragile, I considered returning it, as it had no mounting bezel. After writing Data Signal and learning that they wanted a 10% restocking charge, I decided to keep it. I was assured by them that, in spite of its appearance, it was very durable and reliable.)

I tried to use acoustic coupling in my first attempt, but there was considerable distortion present both on the air and on the scope. Rather than rebuild the acoustic coupler (after all, I did want to use the thing before old age set in), I decided to mount the pad directly on the HT-144B.

The instruction sheet accompanying the SME pad suggested mounting it with double-backed polyfoam tape. Being of a more conservative nature, I decided to make a bezel for it and attach it with screws. Besides, I decided, a bezel would make it look more professional and finished.

The bezel I made was laminated from three pieces of one-sixteenth-inch-thick-copper, one-side-glass epoxy board. I fashioned the top layer with twelve cutouts to frame the characters on the pad. This included beveling and rounding the inside edges of each cutout for better appearance and finger comfort when dialing.

The second layer was just a frame which was cut out to just clear the pad within the cutout area. The third piece was also cut out to clear the underside of the pad where the wires from the tone generator board are soldered.

Next, the three pieces were put together temporarily in sequence and clamped. About three-sixteenths of an inch (1.5 mm) in from each edge at the corners, I drilled a hole to just clear a #3 machine screw. After this was done, I stripped off the copper laminate, finish sanded, and cleaned the whole assembly with lacquer thinner. Then I sprayed the front layer and all edges with a flat fast-drying lacquer. (A word of caution here: Clean the unit and spray only in a well-ventilated area, preferably out-of-doors. If you have a packing box that makes a good spray booth, you will avoid the spray getting on unprotected surfaces.) The unit was then disassembled and the pad was placed in the "sandwich." This was reassembled, and all was ready for mounting on the HT.

I chose to wire the generator board to the tactile pad before installing the unit on the HT-144B to facilitate assembly.

The next problem was determining just exactly where there was sufficient clearance for the wiring and generator board inside the HT. After pondering and making a few dry runs, I found I could readily mount the pad just below the speaker and the fastening screws for the HT-144B circuit board. A close inspection revealed that the generator board would snuggle up partially between the HT-144B circuit board and the case with a small amount protruding into the battery area. With this in mind and using the bezel for a pattern, I drilled the holes to mount the assembly; then I made a cutout 1.1 inches (2.8 cm) long and 0.93 inch (2.4 cm) wide in the HT case. This cutout allowed the generator board to be worked through the case to its position inside. (Be sure the cutout is oriented so that the short side is parallel to the long side of the case. Also, I found it prudent to wrap the generator board with a layer of black plastic electrical tape before putting the thing into the unit; this precludes any short circuits.)

After everything was in place, I soldered the leads from the generator board to the transmitter board: black to ground, red to the circuit side of the power switch, and green to the point where the

speaker lead runs to the audio IC input coupling capacitor. (In this rig, the speaker doubles as the mike.)

I attempted to dial up the repeater, but it refused to cooperate. Well, old-timers make mistakes, too. Mine was that, since the speaker had only eight Ohms to ground, the impedance was too low for the pad output, and the pad was effectively grounded.

That was the last problem to solve and, since I needed a quick solution, I decided on a mechanical switch.

Now, it just so happened that the good people at S.D. Sales in Dallas had included as a premium with a recent order to me a quantity of miniature SPDT slide switches. They were perfect for the job, so I used one. I drilled mounting holes and made the cutout for the button just above and centered on the dialing pad. Be careful to make sure you bend the lugs of the switch down a bit. If you don't, there's a chance they will short against the assembly inside.

After all the parts were mounted, I removed the speaker lead and the generator board lead from the transmitter board and soldered them to opposite poles of the switch. The common lug of the switch was connected to the audio input coupling capacitor, the point from which the speaker lead had been removed. Then everything was replaced in the HT case.

This lash-up works well, and the only inconvenience is moving the switch from the "listen" position to the "dial" position the three times necessary to use the pad. (I say three times because I always dial up the repeater, switch back to make sure I have a dial tone, switch to "dial," dial the number, and then switch back to "listen.")

Now, if someone will only come up with a logic switch for this application . . . ■

New Products

from page 71

pose 100,000Ω/V dc VOM is fuse- and relay-protected against overload on all ranges and functions. It employs a high-quality, easy-to-read taut-band meter movement with color-coded scales and mirror, and precision resistors are used throughout for long-term stability and accuracy. Its price is $68.00.

The instrument measures dc voltages as low as 1 mV, and up to 1,000 V in eight ranges; ac (rms) from 100 mV to 1,000 V in five ranges; dc current from 0.1 uA to 10 A in seven ranges; resistance from 0.25Ω to 20 megohms in four ranges; and decibels from −20 to +36 dB. It has a special jack that can be used to measure ac current from 0-10 A, and a polarity switch to permit dc measurements without reversing test lead connections.

A push-button on the front panel permits rapid reset of the protective relay should the meter be accidentally overloaded.

The VOM's dc voltage, ac voltage, and dc current accuracy is ±3% full-scale. Its rugged light blue ABS plastic case measures 6-5/8" (17 cm) x 5" (12.6 cm) x 2-3/4" (7 cm), and it weighs 1.5 lb (0.69 kg). It is supplied with two test leads, a spare fuse, and an operating manual.

For further information, contact Robert Liska, *VIZ Test Instruments Group, 335 E. Price Street, Philadelphia PA 19144; (215)-844-2626.*

VIZ's relay-protected VOM.

EICO ADDS NEW MODEL 4A4 MULTIMETER TO TRUVOHM LINE

EICO Electronic Instrument Co., Inc., is adding a new multimeter, Model 4A4, to its Truvohm® line of low-cost, high-quality factory-assembled VOMs.

The new multimeter is a 4000 Ohms/volt general-purpose instrument with 17 ranges. The meter measures up to 1000 volts dc and ac, up to 250 mA dc and up to 2 megohms resistance. Accuracy is ±3 percent on dc and ±4 percent on ac. It features a recessed selector switch and an easy-to-read 3-inch meter with mirror-back scale. The movement is diode-protected. A high-impact plastic case is used; it measures 5" by 3½" by 1-7/16". Suggested price of the new Model 4A4 is only $17.95, assembled and complete with batteries and test leads.

The EICO Truvohm line includes a highly sensitive 100k Ohms/volt bench-size multimeter and a clamp-on ac current tester. The line also includes seven other instruments ranging from a simple, inexpensive 1000 Ohms/volt meter to a 20,000 Ohms/volt mirrored-scale meter.

For further details, contact *EICO Electronic Instrument Co., Inc., 108 New South Road, Hicksville NY 11801; (516)-681-9300.*

Ham Help

I am in need of information on adding AM phone capability to a Heath SB-102 transceiver.

David Unkles WA2UIS
Box 212
Mendham NJ 07945

Being a subscriber to your magazine for five years, I feel disappointed in not being able to find any articles on how to build beam antennas for 35, 155, and 454 MHz. I am a monitor buff and would like to increase my listening range, but futile trips to local electronic houses have not produced one magazine that lists charts to build or modify existing products. The *VHF Handbook* only lists amateur beams, with no conversion to go higher or lower. Those commercial beams are out of sight, so perhaps you or one of your readers could supply this info. I would be eternally grateful.

John P. Snyder, Jr.
355 Lackawanna B-8
Reading PA 19601

I have an ASR-32 machine. Could anyone help me find the local loop and convert the machine to operate a TU unit?

I am just getting into RTTY. Any information would be greatly appreciated. Thank you.

Joseph Schwartz K2VGV
43-34 Union Street
Flushing NY 11355

Relief for the Rockbound

— *continuous tuning for FM rigs*

John F. Sehring WB2EQG
PO Box 306
Oradell NJ 07649

Since tuning the bands has always been a favorite amateur pastime, having your 2 meter FM receiving capabilities "rockbound" can be a frustrating experience. Crystals for each channel would be too costly (not to say impractical), and synthesizers are nice, but costly. "Rolling your own" tunable front end for 2 meters would be a challenge, but . . .

Presented here is a simple modification to add continuous 2 meter receive tuning to FM transceivers (or receivers) presently using crystal control for receive. It is adaptable to most FM equipment, whether tubed or solid state, wide or narrow band, just as long as the unit has a 10.7 MHz i-f frequency at some point in its signal-processing chain. Depending on the particular model involved, this modification may require few or no changes in the existing circuitry and will not alter crystal-control or squelch functions.

A Heathkit GR-98 VHF AM monitor receiver, picked up cheaply at a swap session, will provide the necessary parts for this project. It is solid state with 108 to 136 MHz coverage (in its original form), has a 10.7 MHz AM i-f strip, and has a completely separate shielded tuner, 6:1 vernier, and tuning dial. This tuner uses bipolar devices with tuned rf, mixer, and oscillator stages and has a low-impedance 10.7 MHz output. See Fig. 2 for a GR-88 schematic (similar to the GR-98).

Now, the plan of attack is to modify the tuner to cover 2 meters (with full bandspread), remove it from the donor GR-98 receiver, and use it to inject a 10.7 MHz signal into a suitable point of the transceiver's i-f strip. Thus, the original input frequency of the transceiver is not relevant — just be sure that its i-f frequency is 10.7 MHz (or close to it), as you will be bypassing its original front end. See Fig. 1.

If the GR-98 donor receiver is working at all, it would be easiest to modify the tuner to cover 2 meters before removing it. In case the donor receiver is not working, the following retuning may be done after the tuner is electrically connected to the transceiver. To get the tuner on 2 meters, back off on the tuner's rf, mixer, and oscillator padder capacitors and inductors, T101 and C102 (rf), L101 and C109 (mixer), and L102 and C112 (oscillator). See Fig. 3. A signal source would be helpful, but on-the-air signals will do for rough calibration. To bandspread 145 to 148 MHz over the entire range of the tuning capacitor, remove all but the end rotor plate from each of the three sections of the variable tuning capacitor. Then, readjust the oscillator

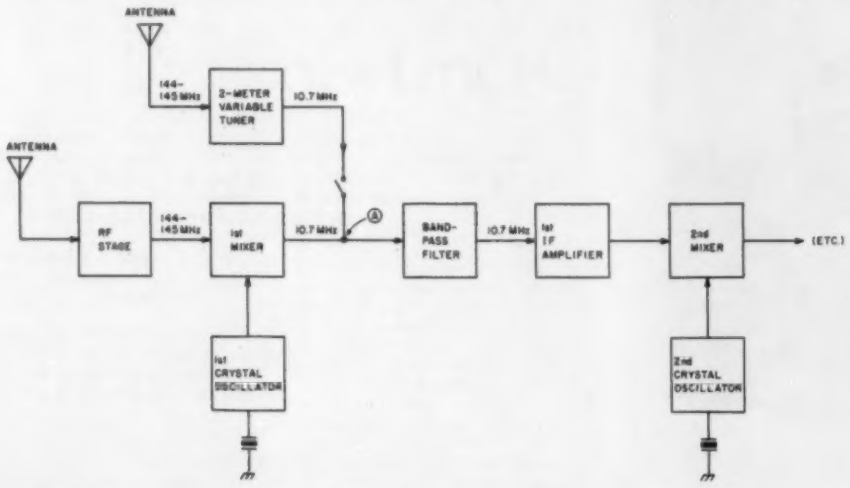

Fig. 1. Block diagram. Typical crystal-control double-conversion FM receiver strip.

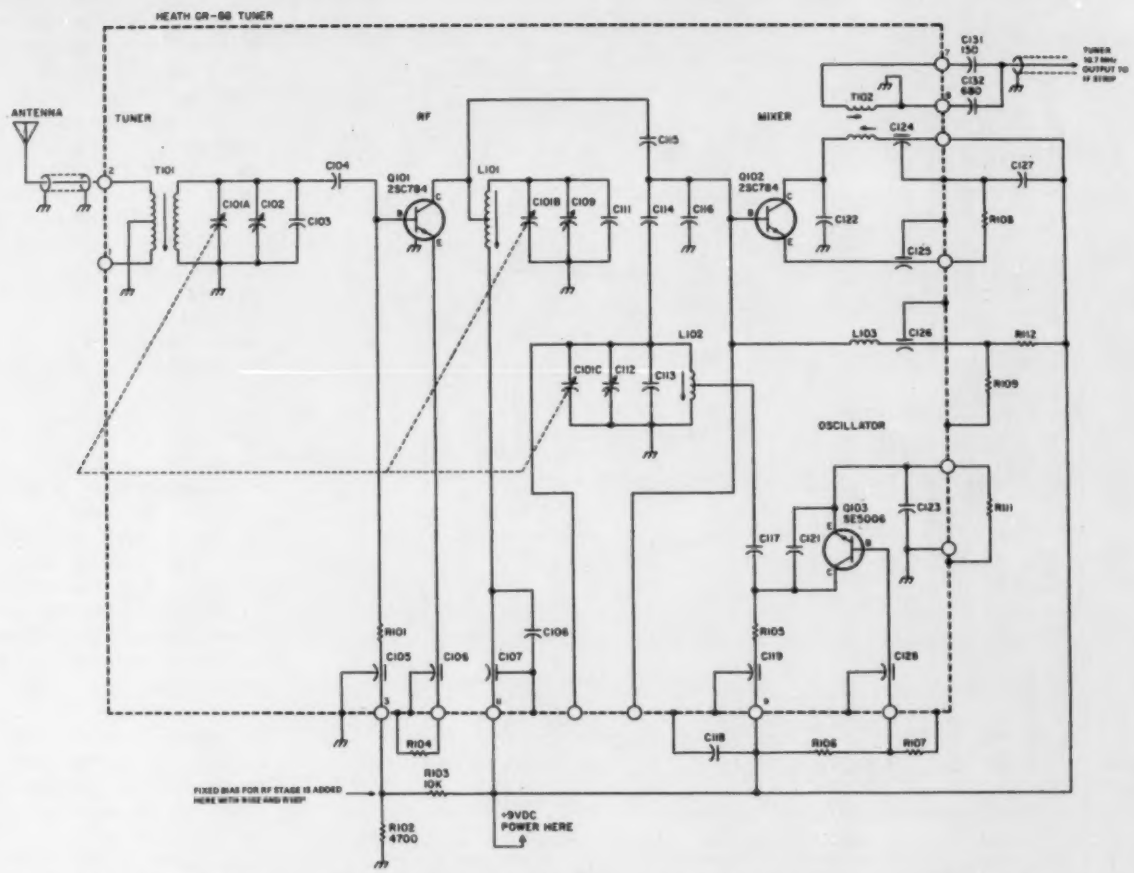

*Fig. 2. Schematic of GR-88 tuner. All resistors and capacitors shown outside of the dotted line and without a value are included with the basic tuner package. *Instead of R102 and R103, a 10k pot could be a sensitivity control.*

with L102 at the low end and C112 at the high end of the band for the exact bandspread you desire. Next, alternately trim T101 and L101 (rf and mixer stages) at the low end of the band and trim C102 and C109 (rf and mixer stages) at the high end of the band until the rf and mixer stages track with the oscillator as well as possible. You may want to knife the rotor plates slightly to obtain even better tracking, but do it carefully — the rotor plates are quite fragile. It's worth the effort to perform these adjustments carefully to achieve best cross-modulation rejection and sensitivity.

To get the tuner operating with the new transceiver, a few simple things need to be done. First, this tuner, being part of an AM receiver, gets agc voltage from its associated AM i-f strip. For FM service, the rf stage should be run at fixed high gain to insure adequate sensitivity and limiting in subsequent stages. Fig. 2 shows how fixed bias can be added using only two resistors, R102 and R103, at point 3. A coaxial antenna connection is made at point 1 or 2. Then install a short piece of low-impedance coaxial cable from the tuner

Parts List

Description	Heath part number	Approximate price
Tuner for GR-98 (108-132 MHz)	110-52	$25.00
6:1 vernier	100-863	$ 2.80
Tuning dial	464-57	$ .70
Tuning knob	462-230	$ 1.90
Tuner mounting bracket (need 2)	204-955	$ .65 each

Available from: Heath Company, Parts Department, Benton Harbor MI 49022, or local Heath retail outlets may have some of these parts and/or can order them for you.

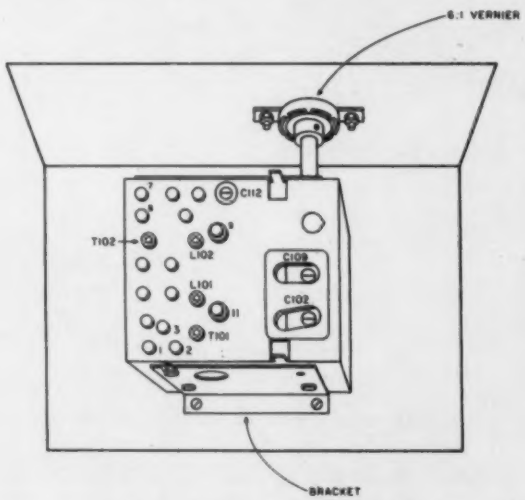

Fig. 3. Plan view of GR-88 tuner.

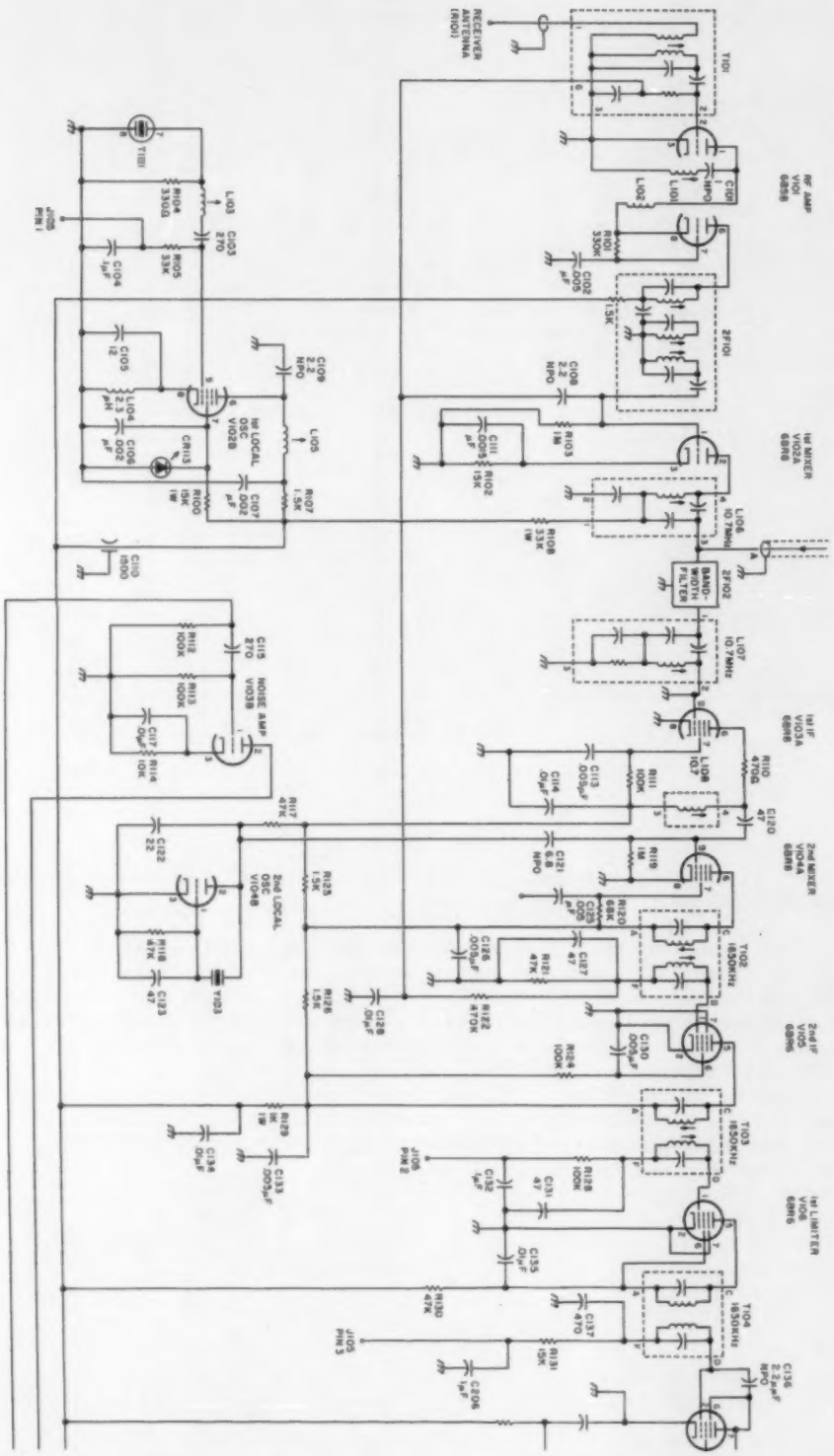

Fig. 4. Partial schematic of Hammarlund FM-50A i-f strip showing injection point.

output, points 7 and 8, to be connected to the transceiver i-f strip. Low-capacitance cable would be best but is not strictly necessary. Last, the tuner will need +9 V dc at point 11, as shown in Fig. 2. This voltage can be supplied from batteries (current drain of the tuner is quite small) or from the transceiver power supply via a zener diode and dropping resistor.

Now, take a particular FM transceiver, in this case a Hammarlund FM-50A — all tubes, double conversion, with a 10.7 MHz first i-f using a 13 kHz bandpass filter. This i-f strip, while not really sophisticated, is reasonably representative of many i-f strips. The idea is to select the best point in its i-f strip to inject the output of the tuner. The point chosen is just after the first mixer plate transformer, at the input to the bandpass filter, point A on Fig. 4. This makes full use of the i-f strip's selectivity, gain, and limiting characteristics. Also, since the output impedance of the tuner is about 50-100 Ohms and the input impedance of the bandpass filter is about 1k Ohm, the tuner output is not loaded down, and plenty of signal is available. One could, however, juggle the values of the capacitors at T102's secondary, C131 and C132, to match more closely the input impedance of the i-f filter or strip used. If you do decide to change the capacitors, remember that the total series capacitance across T102's secondary winding must remain about the same so that T102 continues to resonate at 10.7 MHz.

If you can't find a junked or used GR-98, order the tuner from Heath; see the parts list for details. As mentioned, Heath also manufactures a virtual twin to the GR-98. It is the GR-88 VHF FM monitor receiver. The GR-88 has the same kind of tuner as the GR-98, except for a frequency coverage of 152 to 174 MHz, and has an FM i-f strip. Using the GR-88 tuner might be a satisfactory alternate choice. To cover 2 meters, though, it would be working at the low end of the tuning range instead of the upper end, as with the GR-98 tuner. The conversion would be the same with one exception: After pulling the

variable capacitor rotor plates to achieve enough bandspread, there would not be enough total circuit capacitance in the rf, mixer, and oscillator stages to tune down to 2 meters. Therefore, extra fixed disc ceramic capacitors would have to be added across C103 (rf), C111 (mixer), and C113 (oscillator) to provide more capacitance.

Some final notes: As with any oscillator running at 136 MHz, mechanical rigidity and power supply stability are important for ease of tuning and low drift. I used the matching 6:1 vernier, tuning dial, and brackets that came with the GR-98. It all fits together well and makes for smooth tuning. The tuner is small enough (about 3"W x 3"D x 2"H) to fit inside the Hammarlund case but could more easily have been externally mounted in its own case. To restore crystal receive operation in the Hammarlund, I simply remove the voltage from the tuner and plug the receive crystal back into its socket; something more elegant could be arranged. The tuner's output frequency may be adaptable to 11.5 MHz, but I haven't tried it.

The sensitivity of this combination is quite okay for local work, about 1 uV for 20 dB SNR. Selectivity is mostly dependent on the particular i-f strip and filter used. The Hammarlund can easily separate three strong repeaters spaced on adjacent channels with little problem. Cross-modulation is sometimes a problem from a very local repeater (line of sight from my location). The tuner's tuned rf and mixer stages help minimize such problems, but, with bipolar devices, you can't expect perfection. No images or other spurious responses have been noted. FB QSY on 2! ■

Looking West

from page 16

SMA VS. REPEATER COUNCIL: WHAT'S THE DIFFERENCE?

Since repeaters sit in the same spot day after day, a way had to be found to keep them from interfering with one another. Out of this need was born the concept of voluntary coordination. The end result in many cases was the repeater council. By and large, most councils are political in nature and have the technical aspects of their operation delegated either to an individual or to a committee. The council itself acts as a political voice in the amateur community, letting people know what its area's FMers are doing and why. At times, the political and technical aspects of operation intersect, especially when a council is called upon to mediate a confrontation between two or more systems.

When deregulation came along, FM was suddenly set free to roam and wander like any other mode. Not that it had had any real restraints before. However, with the repeater activity centered in the upper two megahertz of two meters (with the exception of a few isolated places like California, we are addressing a 2 meter question here), very few FMers bothered to wander into the area below 146 MHz. Those who did were the ones with the multi-mode radios, and below 146, their FM operations gave way to SSB, CW, and AM for the most part. Then came deregulation and a new repeater subband from 144.5 to 145.5 MHz. FM was no longer isolated as it had been. Suddenly, it was all over the place—sometimes in places it really didn't belong. It was on top of EME contacts, or atop a DX opening to Hawaii on SSB. Needless to say, the other spectrum users, a good number of whom had never even bothered to listen to FM above 146 MHz, were more than slightly irked. It was obvious that if the transgression were to continue unchecked, an intermode confrontation would develop. In this case, FM would lose. Solving this potential problem would require the establishment of lines of intercommunication among all spectrum users, for the purpose of working to develop the guidelines and peer pressure necessary to insure the sanctity of all modes and all spectrum users. To do this, the SCRA had to open its structure and give voting rights to all interested parties. When it did, it ceased being a "repeater only" entity. Since it was now concerned with the whole band, it had entered into total spectrum management.

Now that the foundation has been poured, the real work begins. Already, an open dialogue exists with the southern California chapter of Sidewinders On Two, and very shortly the two will begin working together on a large-scale education project aimed at all spectrum users. After all, education and cooperation are the real keys to good use of the two meter spectrum in southern California. This education project will include such things as a guide to overall operations on the band (which will be supplied to all equipment outlets), a taped QST explaining and demonstrating the operation of various modes (to be made available to area repeaters), and formalized two meter band plan (for use in all area repeater directories).

I would like to give credit to three people who are really responsible for the turnaround. If it had not been for them, there is a good chance that what we now have might never have come into existence. First there is Herbert "Pete" Hoover III W6ZH. His speech to the SCRA that we reprinted in this column was the impetus that we needed. Thanks to him, the idea took root and began to grow.

Then there is Bob Thornburg WB6JPI. Bob is a very forward-thinking individual who believes in people. Bob cared, and that helped make it happen.

Finally, it was Art Gentry W6MEP who sold the concept of an open organization with a broad-based voting membership. Had he not come out publicly for it, there is a good chance that it might not have sold.

Thanks in good part to these three gentlemen, the coming of a new ideal in overall spectrum development has become part of the southern California VHF environment. We are lucky to have them.

Ham Help

I need a manual or schematic for a Collins R-389/URR, 15- to 1500-kHz receiver. I also need information on the Rycom 2174A Freq. Selective Voltmeter. Also, I would like to contact people in my area who are interested in the 1575 meter band.

Larry Bearse WA1LGQ
132 Christine Drive
East Hartford CT 06108

I'm looking for either the Hammarlund PRO-200 or HXQ-300 transceiver or any information on these units, i.e., manuals for copying, old ads, etc. They were built about mid-1960, could both operate on 160 through 10 meters, and were rated at 300 Watts input on SSB.

Rick Markey WB3CFG
157 Weidman St.
Lebanon PA 17042

I have been an amateur radio operator for almost thirty years. During this time, I have had an E. M. Sargent multiband receiver, Model 31, serial number 3019, in good working condition.

Does anyone know the value this receiver would have, either historically or as an antique? I would appreciate hearing from anyone who knows something about the assessment of this receiver.

William Stradley W6BHK
8450 West Vassar Dr.
Lakewood CO 80227

I will pay for an original, or copy, of a schematic diagram for an Eldico SSB-1000 or SSB-1000F kilowatt linear amplifier. The oscilloscope in this 1958 vintage unit is not working properly, and I would like to have the schematic before attempting to repair it. Thanks for any help.

Steve Zahos WB2UNH
128 Tomcyn Dr.
Williamsville NY 14221

I need information on the Olivetti TE300 terminal. I am specifically interested in a service manual for the keyboard/printer unit, ideally with electrical information. A wiring diagram for the power supply unit would also be helpful, but I would appreciate any information. Thank you.

Charles Boelens
7311 Coronado Dr.
Burnaby, B.C.
Canada V5A 1P9

Rodney L. Burt
Box 8128
Boise ID 83707

Power Supply Magic

—*the forgotten voltage doubler*

If you are anything like me, you have at one time or another found yourself in the middle of a very interesting IC project with a board or two full of nice easy-to-use TTL logic parts with a few discretes and the usual complement of resistors and capacitors. Everything is going just fine, and your tally sheet, on the side that you should use to keep track of power supply requirements, is showing a single 5-volt supply running up to about 2.5 Amps. You think to yourself with a smile that here is the perfect place to use that "super zapper" 12.6 volt c-t at 99 Amps transformer that you have hidden at the back of the junk box. It is a real monster with a single secondary and all kinds of reserve for future expansion to the system.

All of a sudden, here comes a subsection to your design that you could accomplish with one moderately-priced MOS/LSI chip instead of 27 TTL packages and 920 assorted resistors and capacitors. The only problem is that it requires three voltages from the power supply you have already designed with just one output—specifically, plus 5, minus 5, and minus 12. The two minus voltages are both at quite low current, such as 50 mA each.

You are now faced with the decision of how to obtain these new power requirements. There are a number of ways to go, and each has its own specific advantages and pitfalls.

The first one which might logically fall to mind would be to use a transformer with a higher output voltage and then divide it down from this level to obtain the various outputs that you need. This approach would be fine if the higher voltages required higher current levels, but, unfortunately, this is not the case here. If you set an upper level of approximately 12 volts and then regulate it down to 5 volts for your TTL logic devices, you would have to use a series-pass transistor or other regulating scheme capable of dissipating 21 Watts for a 3-Amp supply plus a safety margin. This is fine if you want to spend the money, but I don't care to spend the money, and neither do I care to have that much heat floating around inside my otherwise very neat package. You also have to consider here that, since the two minus voltages are at very low current relative to the plus 5 current level, you are effectively wasting the capacity of half of the power transformer. In this day and age of energy conservation and awareness, this just won't do!

The next idea to arrive in the logical route of design choices is the use of a power transformer with multiple secondary windings. Now, if you have had occasion to check the prices on this method lately, you will dismiss the thought just as quickly as I did. I am sure there are those of you out there who will jump up and say, "Why not rewind your own transformer?" This is a perfectly acceptable solution, if you are adept at this sort of thing. But, once again speaking for myself, the last time I got involved with one of these projects, after several days of fighting 9 miles of stiff and kink-prone wire, I was wishing that I could get my hands on the guy who wrote the article about "Winding Your Own Transformers For Fun and Profit."

Another method would be to just add a second transformer for the exclusive use of these two minus voltage levels. I would argue against this idea solely on the basis of the cost of the transformer and all the other miscellaneous parts necessary for this method.

As you may have guessed after reading this far, I have a design to provide all the needed levels for this project which, in my not-so-humble opinion, shoots all these other ideas full of holes. In a way, it could be considered almost something for nothing.

It is based on a circuit which will be familiar to most hams who have been around long enough to have worked with tube circuits. In this modern day and age of transistors and ICs, with their low voltages and high currents, it has fallen into disuse. I am speaking of the voltage doubler, although, when I get done with it, you might not recognize it at first glance.

I believe that, at this point, a bit of background

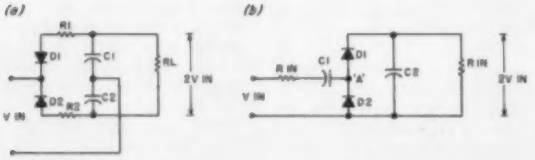

Fig. 1. (a) Conventional or full-wave doubler. (b) Cascade or half-wave doubler.

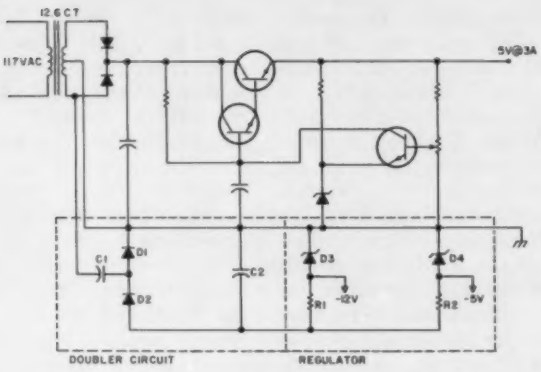

Fig. 2.

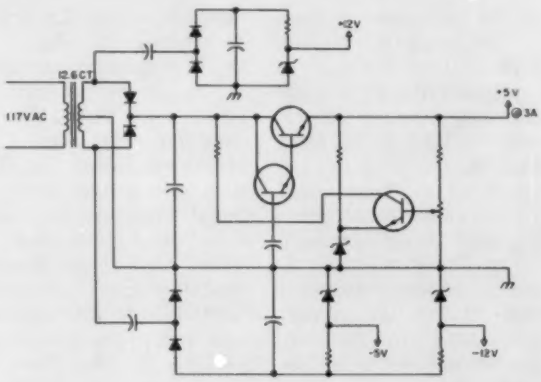

Fig. 3.

on the internal functions of the voltage doubler circuit itself would be in order.

Fig. 1 shows two common voltage doubler circuits. In Fig. 1(a) is the conventional full-wave doubler, and in Fig. 1(b) is the cascade or half-wave doubler circuit. Each of these circuits offers the same advantages or disadvantages as its namesake in the standard rectifier circuit. The full-wave doubler offers higher average output in both current and voltage, depending on the load applied to it, and requires less filtering. The half-wave circuit uses fewer parts but does require much heavier filtering to achieve a similar output.

For the needs in this application, the half-wave circuit has one major feature which dictates its use. It has a common input and output side that can be grounded for a reference to the main power supply.

To understand how a voltage doubler operates, please consider Fig. 1(b). The voltage of this supply is taken across capacitor C2, which is charged on alternate half cycles. When the input is in its negative half cycle, D2 conducts and charges capacitor C1 to the peak input voltage. On the next half cycle of input, the input signal reverses polarity and is now in series with the voltage across C1. The voltage at point "a" is now equal to E_{in} plus Vc, or twice the peak input voltage. Diode D1 now conducts and charges capacitor C2 to this higher voltage. The output voltage of the doubler is already partially filtered, due to the presence of the charged capacitor across the output terminals. This filtering should be quite adequate for most uses for which you might consider this circuit, but there is no reason why you could not provide more filtering or even some sort of regulating circuitry. It should be mentioned that the output voltage of a voltage doubler circuit is quite load dependent and neither the full-wave nor the half-wave circuit provides much in the way of self-regulation.

There is nothing really critical in the selection of parts for use in a doubler, except that I would definitely recommend the use of very good high-quality capacitors, since they must carry the total load current continuously. I have not come across any set formulas for calculating the size of these capacitors. In the days of tube usage, it was common to use 40 to 50 uF for C1 and C2, but I have found in my development of the circuit I am about to describe that values of 220 uF have provided adequate current levels. The working voltage of the capacitors should be at least twice the input voltage for C2 plus a safety margin, while C1 can be specified for use at the input voltage. Since the circuit is capacitively loaded, you must also use diodes of good quality because they will see relatively high surges. I would never consider using anything less than something in the 1N4001 series with their 1-Amp continuous rating and correspondingly higher surge rating. The resistances shown in Figs. 1(a) and 1(b) are basically there to simulate the source resistances from the transformer and diodes, although you could insert some surge limiting resistance if desired.

Up to this point, I have been speaking of a type of circuit which will give a positive output with respect to common line. However, at the start of this article, the problem was that I needed two negative voltages. As simple as it may seem, I can do this by taking the basic cascade or half-wave doubler circuit and reversing the polarity of everything.

The details of this procedure are shown in Fig. 2. This is the schematic of a power supply that I have used with considerable success in a number of projects which have been custom made at my company. The upper 5-volt section is quite conventional, with an NPN series-pass transistor driven by another NPN transistor set up as a "differential amp." A number of articles have been written regarding this type of circuit, so I will not go into it in detail, except to say that this particular one uses a 2N3055 for the series-pass transistor, and I draw a continuous 3 Amps from it without any problems. I do, however, have a hefty heat sink mounted for the 2N3055. Proper selection of the transformer, diodes, series-pass transistor, and heat sink would allow you to draw almost any current level you might desire.

The lower section is the one to be more concerned with. If you will compare it to Fig. 1(b), you will see the similarity. It is the mirror image of the half-wave doubling circuit and, as a result, provides a negative output. You can connect the input to the doubler to either side of the transformer secondary, but just be sure you connect it in front of the rectifiers for the other section of the power supply. The actual voltage on the more negative end of C2 will depend

on the secondary voltage of the transformer you choose to use, but you can essentially assume that the unloaded voltage at this point will be 2 V_{in} peak (i.e., rated secondary voltage × 1.414). I have added the two zener regulators to this negative voltage to obtain the two levels necessary to supply the MOS/LSI chip. At very low current levels (10-15 mA or less), there is no need for a filter capacitor on these regulated voltages. However, if you wish to draw more current, they would most likely be necessary. If you understood the previous explanation of the mechanics of a voltage doubler circuit, you should be able to see the workings of this circuit with very little study.

To expand on the possibilities of this type of circuit, look at Fig. 3. Here you have a power supply which provides 5 volts at high current levels, minus 5 and minus 12 for the MOS/LSI devices, and also plus and minus 12 volts to power an operational amplifier. This circuit is very well suited for use with low-power operational amplifiers because, even though the output has rather high ripple levels, most low-power op amps have a very high power supply ripple rejection capability. All this from a transformer with a single 12.6 volt secondary. How simple and efficient can you get? To me, the word efficiency is one of the most important things to consider with this method.

Should you require higher voltages, you could easily employ higher orders of voltage multiplication as long as they have a common input and output. However, I would recommend that you spend a little time "in the books" before you attempt these levels so that you understand what you can and can't do. Two publications I highly recommend are *Voltage Regulator Handbook* from National Semiconductor and *DC Power Supply Handbook* from Hewlett-Packard. The first I have seen advertised for sale in some of the ads in this magazine, while, for the second, you might have to try and make friends with some engineer so you could beg, borrow, or steal his copy. There may also be others among *73*'s publications from which you could gain further information on the subject. Many libraries have a small section on electronics, and you might be fortunate enough to find something there.

You could build this supply with almost any type of construction practice with which you are comfortable. I generally lay out a small printed circuit board to fit what space I have available which holds all parts except the transformer and the series-pass transistor, which is mounted on its own heat sink or, in some cases, sinked to the chassis. In supplies providing lower power levels, I have even been known to mount the power transistor right on the board in a small heat sink. If you do this, you must watch that the temperature of the device will not rise high enough to damage the board itself or cause problems with some of the other parts on the PC board.

I have used this circuit or variations of it in several hundred devices manufactured by my company over the last 5 years without any problems whatsoever. Within the limitations outlined previously regarding power capabilities and ripple, the circuit will do an excellent job for you. ■

CONTESTS

from page 15

Isls.; OZ—Denmark; SJ/SK/SL/SM—Sweden. Not all of these prefixes are geographically in Scandinavia, but they are considered so for the contest. Operating classes include: single operator, multi-operator/single xmtr, and multi-operator/multi-xmtr. Club stations, even if operated by only one operator, are in the multi-operator class. Multi-operator/multi-xmtr entries are to use separate series of serial numbers for each band. Only allband entries are allowed.

EXCHANGE:

RST and serial number starting from 001, transmitted as a five or six digit sequence.

SCORING:

European stations count 1 point for each complete QSO on any band. Non-European stations count 1 point per QSO for each complete contest QSO on 20, 15, or 10 meters, and 3 points per QSO on 80 and 40 meters. Count each call area in the above mentioned countries on each band as a multiplier, e.g., LA1 = LB1 = LJ1 and SM3 = SK3 = SL3. A portable station in Norway or Denmark counts as the tenth call area there, e.g., W4XXX/OZ counts for OZ0 and G4XYZ/LA counts for LA0. SJ9 is the 9th call area in Sweden. OH0 is the 10th call area in Finland, and OJ0 is a separate call area. Some countries have no geographical call areas, but count as if they had. The final score is the sum of all complete QSO points from all bands multiplied by the sum of all multipliers from all bands.

AWARDS:

Certificates will be awarded to the highest scoring station in each operating class on both CW and phone in each participating country as well as in each USA call area, reasonable score provided. Depending on the number of contestants in each country, the Contest Committee will consider more certificates.

ENTRIES:

Contest logs are to be filled in in the following order: date/time in GMT, station worked, sent/received message, multiplier, and points. Separate logs for each band and CW/phone are recommended. On the summary sheet the contestant will write his/her callsign, name, address, the final result, and the operating class, along with a signature that he/she fully agrees to the rules. The logs must not be mailed later than October 15th and should be sent to: EDR Contest Manager, Leif Ottosen OZ1LO, Bankevej-en 12, Kong, 4750 Lundby, Denmark.

DELTA QSO PARTY

Starts: 1800 GMT September 23
Ends: 2400 GMT September 24

All amateurs are invited to participate in the ninth annual event sponsored by the Delta Division of the ARRL. There are no time or power restrictions. Amateurs outside of the Delta Division will attempt to contact as many amateurs inside of the Delta Division (Ark.-La.-Miss.-Tenn.) as possible. Delta Division amateurs will attempt to contact as many amateurs as possible both inside and outside of the Delta Division. Stations may be worked on each band and mode. Portables may be reworked on the same band/mode if they change counties. DX stations may be worked by Delta Division stations, but do not count as multipliers.

EXCHANGE:

QSO number, RST, and QTH: ARRL section for non-Delta Division, county and state for Delta Division.

FREQUENCIES:

CW—3550, 7050, 14050, 21050, 28050; SSB—3990, 7290, 14290, 21390, 28590; Novice—3725, 7125, 21125, 28125.

SCORING:

Delta Division score number of QSOs times number of ARRL sections (75 max.). Outside division score number of QSOs times number of counties worked (316 max.).

AWARDS:

Delta Achievement Award to all amateurs contacting 5 different stations in each of the 4 states comprising the Division. Section award certificates to the 3 highest scoring stations in each state in the Delta Division. Fourth and fifth place awards if warranted. Section award certificates to the high scoring stations in each ARRL section and country outside of the Division. Second and third if warranted. Plaque will be awarded to the highest scoring station both inside and outside of the Division. Plaques will also be awarded to the high scoring portable and mobile stations operating in the Division. A portable or mobile station is here defined as a station operating outside of his home

Continued on page 85

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H8

DVM Scrapbook

—*the basics*

Gary McClellan
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La Habra CA 90631

Quite a few people are unaware that digital voltmeters can be very useful to them, and quite a few others think that DVMs are good for nothing but digital multimeters. I am going to do something about those notions in this article!

But before I get started showing you how to use digital voltmeters, let's take a quick look at the advantages of the DVM, and, to be honest, a few disadvantages, too. DVMs are rapidly being incorporated into electronic equipment as replacements for conventional analog-type meters. They are far more than "window dressing," as they give a bright unambiguous reading that is hard to ignore. This feature makes them great in places where the public has to read them. Have you seen a digital gas pump or cash register yet? And DVMs will be seen in even more places as prices decrease. DVMs (and many other digital instruments for that matter) do have one serious disadvantage: It is hard to spot trends by the readout. By this I mean that, supposing you are monitoring the level of a slowly emptying water tank, watching the slowly changing readout is hard. But science has come to the rescue with analog bar graph displays that solve that problem!

Let's take a quick look inside a typical digital voltmeter, for example, the Gary McClellan and Co. model 101 DVM kit. Actually, this kit is for a digital panel meter, or DPM for short. DPMs are the building blocks of modern

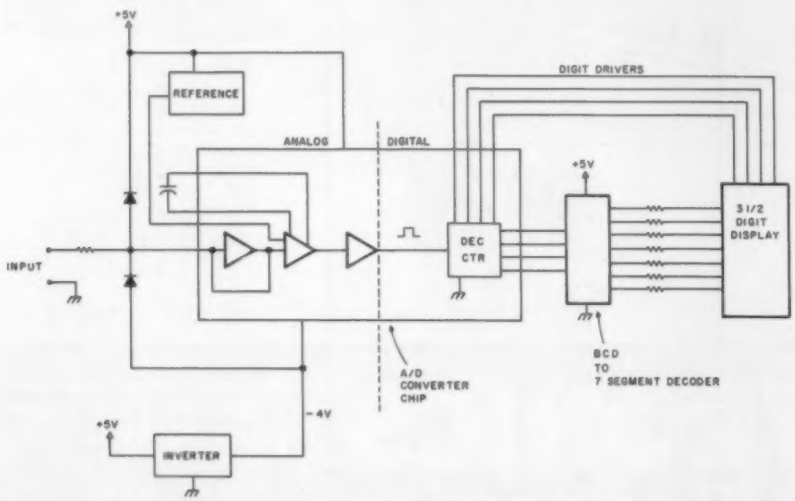

Fig. 1. Block diagram of the model 101 DVM kit. This is a typical modern DVM circuit. The A/D converter is a Motorola MC-14433 IC chip. Only the basics are shown here.

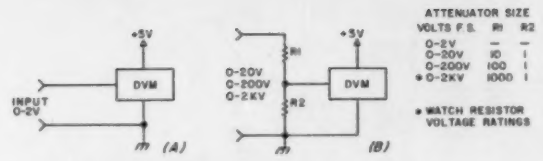

Fig. 2. DVM hookup schemes. A shows the direct connection for a 0-1.999 voltmeter (0-2 volts, for short). B shows some basic attenuators for higher voltages.

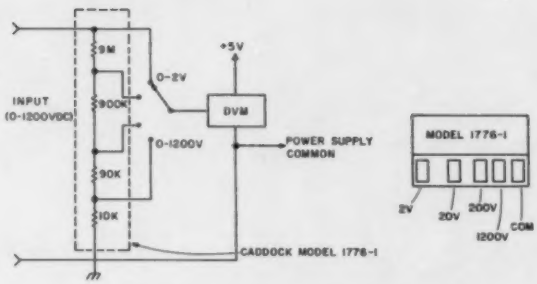

Fig. 3. A full-blown attenuator scheme, like those used in commercial digital multimeters. Note that the ranges are 0-2 volts, 0-20 volts, 0-200 volts, and 0-1200 volts.

equipment, and they usually replace analog meters directly with only a source of power needed to run the unit. The model 101 is shown in the block diagram of Fig. 1. As you can see, this digital voltmeter is a marriage of analog circuitry and digital circuitry. This is true of all digital voltmeters. This unit has the bulk of the circuitry on a single IC chip, and that makes a difference. In fact, this unit has only two other IC chips — one drives the display, and the other acts as an inverter, changing the 5-volt power into minus 4 volts for the internal op amps on the DVM chip.

This DVM kit uses the dual slope method of converting an analog signal into a digital one. This is the standard method of signal conversion, and, since it features high accuracy at low cost, it is used everywhere. Basic operation is something like this: The first step is for all op amps to be zeroed and the digital counter section (which drives the display) reset. Then any positive input voltage (the one you want to measure) is compared with the reference voltage (did you notice the reference block in Fig. 1?), and the ratio of these two voltages is converted into a stream of digital pulses. The pulses are counted up and displayed as voltage. Next, any negative voltage you may apply is compared to the reference; then the ratio is counted and displayed as voltage, like before. In the final step, everything is zeroed out and the process repeats itself. These steps are controlled by a built-in digital timer, a necessary feature of the dual slope voltmeter. I've left out a lot of the theory to keep this section painless, but you should have an idea of how the dual slope system works in its basic form.

The quickest and easiest use for DVMs is as a simple dc voltmeter. Fig. 2 shows a typical hookup. If you are like most people, you will want to measure more than the 0 to 2 volt scales these meters measure, so you will need an attenuator as shown. You can use precision resistors for the values shown; Radio Shack and others have offered a resistor pack that will give close values (hopefully). Anyhow, it's worth looking into. If you don't need the 10-meg input impedance of the divider shown, you can use other values of resistors. Let's assume that you are measuring the output of a 0 to 20-volt power supply. Just pick two resistor values that come close to make the 10 to 1 voltage divider you need. You can probably use something like 166k for R1 and 16k for R2 with no problem. The calibration control on the meter will adjust for this. In fact, I did just this trick in the power supply featured in the original MC-1405 DVM article and it worked like a charm! The only real restrictions you should worry about are that the resistors must be precision wire-wound or film type and you must not use values so low that you load down the circuitry you measure.

Another use for a dc voltmeter is in communications gear. How about a digital plate voltage meter? Or how about a digital circuit checker in a communications rack (say a 2 meter repeater)? Perhaps someday soon all quality communications gear will have some sort of circuit tester built in. Wait and see! If you wish to build that classy digital plate voltage meter, the job is pretty simple. Find out what voltages you will be measuring and plan the attenuator accordingly. Suppose you want to measure 1 kV full scale in your linear. That means you must provide 1.000 volt or so to the meter. You need an attenuator of 1000 to 1, of course, and Fig. 2 shows some suggested values. Some important tips: For safety, always run the meter common at chassis ground potential. This will mean safer operation for the meter. If its power supply transformer arced to ground, the DVM could be damaged. Also, use several high-value precision resistors in series; many precisions have 500-volt ratings. Of course, you will have an easier time finding lower values to put in series. After you install the meter, you may want to add a switch so you can measure other voltages. The amplifier bias voltages are good candidates; just select an appropriate R1 for your application. Note: The MC-1405 DVM will not measure negative voltages, so keep this in mind if you build this DVM.

Moving along further, you might want a multiple-range dc digital voltmeter for the lab. Fig. 3 shows how to do it. The easiest and best way I have found to tackle a multirange attenuator is to buy a commercial resistor network. You get all the tough-to-get resistor values in a single package, and it's ready to go — just add a switch! The attenuator shown in Fig. 3 will measure 0-2 volts, 0-20 volts, 0-200 volts, and 0-1200 volts. The reason the top range is 1200 volts and not 2000 volts is due to the voltage limitations of the resistor. This part is made by Caddock Electronics[1] and the part number is 1776-1. You can also get it from me, as well as a switch, for $12.95 plus $1.50 postage and handling. Since this price is about the same as theirs ($12.00), you can get both parts and save money. Or, if you prefer, you

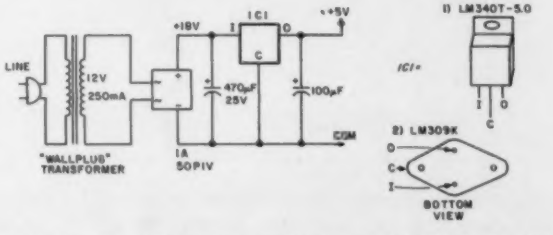

Fig. 4. Simple DVM power supply for model 101 DVM. See text for MC-1405 power supply.

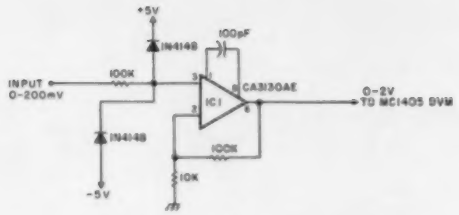

Fig. 5. 10x amplifier for 0 to 1.999 mV reading on the MC-1405 DVM.

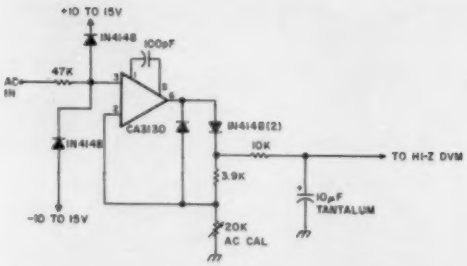

Fig. 6. Simple high-quality ac converter. Circuit from Motorola MC-14433 application notes.

can get 0.1% resistors in the values shown from Mepco-Electra and others.

Here are a few other uses for a dc voltmeter: Why not attach a permanent magnet dc motor and make a digital tachometer? Or rig up a photocell pickup for a more accurate noncontact tach. How about a simple digital thermometer? These DVMs will read the output of a thermocouple directly on a 200 mV input range. You can check circuitry for destructive "hot spots," check heat sinks, appliances around the home, and much more. Now surely you can think up more uses than that!

A few words about powering your voltmeter! Always use a separate power supply to run it. The one shown in Fig. 4 will do nicely. Don't be tempted to tap power from the circuit you are going to measure; the DVM may inject noise back into the supply through the power leads. I even used a separate source of power on my Heath lab supply. It paid off in a quite dc output. Look for an extra transformer winding in your equipment of at least 6 volts or more at around 100 mA. If you have one (the Heath supply did), you can eliminate the expensive power transformer shown in Fig. 4.

After you have the meter running, calibration is in order. Simply measure the high voltage, power supply output, or whatever with a digital multimeter of known accuracy. Then adjust the pot in the 101 DVM until the readings jibe. If you built the MC-1405 DVM, the procedure is the same, but you must zero it before you adjust the calibration. Do this with zero output voltage from the equipment your meter is built into, tweak the zero adjust, and apply power. Adjust the MC-1405 calibration pot until both meters agree, and you are all set.

These two DVMs have the potential for being far more accurate (like about ±0.03% typical short term) on a single range than many low-cost digital multimeters around, so get the best meter you can find to do your calibration. By "low cost," I mean the $89.95, 3-digit, 1% accurate TV service-type digital multimeters.

If you would like a 0 to 199.9 mV scale on your DVM for measuring gadgets like thermocouples and the like, the conversion to these meters is easy. On the MC-1405 voltmeter, rewire the input buffer to a 10x noninverting amplifier, as shown in Fig. 5. I would suggest that, if you have the MC-1405 DVM, you use RCA CA-3130AE mini-DIP op amps in place of the LM-308s used in the original unit. The MOSFET op amps have far higher input impedances and they drop in the same socket. If you are working with the model 101 DVM, simply change R4 from 470k to 27k and recalibrate the unit for 199.9 mV full scale. This job takes only minutes.

There's another good reason for converting your meter to 0 to 199.9 mV full scale. If you plan to add current shunts, you should use this range. Why? To minimize something called "insertion loss" or, in other words, the voltage drop across the current shunt. If you lose too much voltage in the shunt, you can cause problems in the circuit you are trying to test and goof up your current readings. Play it wise and use the 199.9 mV scale if you can.

Sometimes it is desirable to read ac volts with your basic dc-type DVM. All you need is an ac converter. Fig. 6 shows the details. You might also want to use the circuit in any digital multimeter designs you are working on, as this is a pretty good circuit. Accuracy is typically better than 0.2% at 60 Hz. Response is good from 30 Hz to over 5 kHz. To my knowledge, this is the first time anyone has published a decent ac converter circuit. This circuit converts 0 to 1.999 volts effective value ac to 0 to 1.999 volts dc. For higher voltages, use the same attenuator shown in Fig. 2. Build this circuit on a piece of ground-plane (PC with perforated copper on one side) perfboard or on a well laid out PC board. Keep all leads short and shield the input leads, as hum pickup comes easily in a circuit as high impedance as this. This ac converter is useful for current measurements, too, as it works well at low voltage levels.

So what can you do with an ac voltmeter? You can build a power line monitor. That's a rather gimmicky project, to be sure, but you could build it into a piece of equipment to check critical line voltages. You would probably want to combine other functions (such as dc volts and current) with this circuit. Fig. 7 shows the culmination of this idea. It's a complete electronic "checker-outer" for a piece of equip-

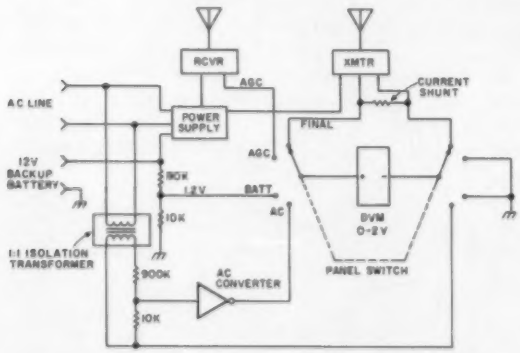

Fig. 7. Super repeater "checker-outer" checks critical voltages and current in repeaters. You should use a 1:1 isolation transformer in the front of the ac line to check the circuit for safety.

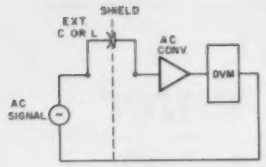

Fig. 8. Simple C or L meter. The signal source is ideally from a constant amplitude signal generator, but a filament transformer will work.

ment such as a 2 meter repeater or you name it. As shown, you can check line voltage, battery backup voltage, current consumption from ac battery, agc check, and final collector current. If this tester were located in a remote repeater station, the selector switch would be remote controlled, and the readout would be converted to audio and "read out" at a distant location. Does this give anyone any ideas? How about a computer "handshake" system?

Another use for ac volts is in capacitance/inductance meters. I am offering this idea as is because I haven't tried it. If you do, be sure to carefully shield ac input from the 60 Hz source, to reduce hum pickup. And try to use a stable ac signal source. A couple of op amps would work for this, and you can use frequencies such as 60 Hz and 1 kHz, which are popular in LC bridges. Fig. 8 shows the details.

I saved the current measuring techniques for last because they can use all the stuff just mentioned. Fig. 9 shows how current is measured. Just use Ohm's Law to get the shunt(s) that you need. I didn't really have to make many comments about current measurement, but I will repeat that you should use the 199.9 mV meter range here. You can cut some slack and use the 1.999-volt range in some applications, such as with tubes, but this isn't always the case. A few comments about the resistors you use: All resistors have tempcos, or, in other words, they change resistance with temperature. So the moral is, don't heat them up. Calculate the wattage with full-scale current and use a resistor of 10x or better this value. If you wind your own resistor with wire, be careful to use very heavy wire or, better yet, resistance wire. One of the worst current shunts I ever made was a 0.1-Ohm resistor made out of #18 wire. The tempco was so bad it easily showed up on an analog meter. Commercial resistor wire is made of nichrome or similar wire and has a better tempco.

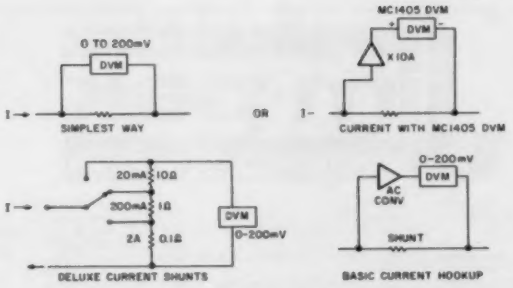

Fig. 9. Current measuring techniques.

I hope these circuits can be of use to you. Stay tuned for some more applications for the DVM kits. The next ones will be more specific in nature, and perhaps more useful. If you have any questions and you write, please enclose an SASE or I'll send a ton of sales literature! ■

Reference

1. Caddock Electronics, 3127 Chicago Ave., Riverside CA 92507.

CONTESTS

from page 80

county for the purpose of operating in the Delta QSO Party. A plaque will also be awarded to the high scoring Delta Division Club station. No limit to the number of operators or transmitters; however, all QSOs must be made from the same location. The Lafayette (LA) ARC will sponsor the plaques.

ENTRIES:

Logs must include date/time, station worked, exchange, band, emission, and multiplier. Logs must be postmarked no later than October 21st to be eligible for award consideration. Logs will be returned if requested. Send logs to Malcolm P. Keown W5RUB, 213 Moonmist, Vicksburg MI 39180.

ROCKY MOUNTAIN DIVISION QSO PARTY

Contest Periods:
2000 GMT September 30 to 0600 GMT October 1
2000 GMT October 1 to 0200 GMT October 2

Call will be CQ de RM on CW or "from Rocky Mountain" on phone. Non-Rocky Mountain stations should refrain from calling CQ! A station may be worked once per band regardless of mode.

EXCHANGE:

Non-Rocky Mountain stations send consecutive serial number and section; foreign stations send RST and serial number. In-division stations send serial number, county, and section.

FREQUENCIES:

3560, 7060, 14060, 21060, 28060, 3920, 7230, 14280, 21360, 28560.

SCORING:

SSB QSOs are one point, while CW QSOs are two points each. Out-of-division stations multiply QSO points by the number of counties. Stations within the division multiply QSO points by the sum of division counties, sections, and foreign countries worked.

AWARDS:

A certificate will be awarded to the highest scoring station in each ARRL section, provided a minimum of ten QSOs have been made, and each foreign country. Second place will be awarded where noteworthy score warrants. A certificate will be awarded to the high scorer within each division, county, and state. County hoppers, defined as stations operating from three or more counties, are eligible for county awards and for certification as high scoring county hopper in the division. Division multi-operator stations are eligible only for certification as division high multi-operator. A plaque will be awarded to the highest scoring single operator station within the division and outside the division.

ENTRIES:

Logs must have county of operation clearly marked; county hoppers should indicate separate county totals as well as a grand total. All logs must be postmarked by October 30th and sent to: Bill Wageman, 35 San Juan, Los Alamos NM 87544 (with an SASE if contest results are desired). By entering, one agrees that all decisions of the contest committee will be accepted as final.

MISS AMERICA STATION

Station K2BR will be operating from the Miss America Pageant, Atlantic City NJ, from September 1 through 10, 1978. Approximate frequencies: CW—3555, 7055, 14055, 21055; phone—3935, 7235, 14280, 21380; Novice—3730, 7130, 21130. QSL to K2BR. Sponsor: Southern Counties Amateur Radio Association (SCARA).

THE NEW JERSEY ALL COUNTY AWARD (NJAC)

Sponsored by the Jersey Shore Amateur Radio Society, this new award is offered for working NJ counties on any band as follows: seven counties for the certificate, and endorsements for each additional seven counties (for a total of 21 counties). Send log information plus $1.00 and two 5¢ stamps to: Wally Eichorn K2CYX, 105 Seaside Place, Sea Girt NJ 08750.

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Modesto — Computer Magic
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Palmdale — Radio Shack A.S.C. Palmdale
Palo Alto — Zack Electronics
Pasadena — Dow Radio Inc.
Riverside — Computer Center
Sacramento — Heathkit Electronic Center
Sacramento — The Radio Place
Sacramento — Zackit
San Bernardino — Inland Computer & Electronics
San Carlos — J & H Outlet Store
San Diego — Radio Shack A.S.C. Mira Mesa
San Diego — Radio-Tronics Inc.
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Ventura — Lombard's Electronics Inc.
Walnut Creek — Byte Shop of Walnut Creek
Westminster — JK Electronics
Whittier — D & S Electronics
Whittier — Whittier Electronics Co.

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Orlando — Altair Computer Center
Tampa — AMF Electronics
Tampa — Microcomputer Systems

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Atlanta — Atlanta Computer Mart

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Aiea — Delcoms Hawaii
Honolulu — Integrated Circuit Supply

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Hammond — Quantum Computer Works

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Clinton — Bridge Elec. Computer Center
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Indianola — Electronix Limited

KANSAS
Kansas City — Electronic Surplus Sales

KANSAS (Continued)
Manhattan — Communications Specialties Ltd.
Wichita — Amateur Radio Equipment Company

KENTUCKY
Lexington — Radio-Electronic Equipment Co.

LOUISIANA
Baton Rouge — Davis Electronics Supply Co.
New Orleans — Wm. B. Allen Supply Co.

MARYLAND
Baltimore — Computer Workshop of Baltimore
Baltimore — Everything Electronic
La Vale — J & M Electronics
Rockville — Computer Workshop
Silver Spring — Computers Etc.
Towson — Baynesville Electronic Inc.
Towson — Computers Etc.

MASSACHUSETTS
Medford — Tufts Electronics
North Adams — Electronics Supply Center
Waltham — Computer Mart Inc.
Worcester — RM Electronics Inc.

MICHIGAN
Ann Arbor — Airway Electronic Communications
Flint — Hobby Electronic Center
Grand Rapids — Micro Computer World
Lansing — Fulton Radio Supply Co.
Mt. Clemens — The Computer Store

MINNESOTA
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Eagan — Computer Room Inc.
Hopkins — Heathkit Electronic Center
St. Paul — Heathkit Electronic Center

MISSOURI
El Dorado Springs — Beckman Electronics
Florissant — Computer Country
Parkville — Computer Workshop of Kansas City

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Pompton Lake — Computer Corner of New Jersey
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Meet Mr. Blizzard

—Dayton hams were ready

National Guard Medivac helicopter prepares to land at National Guard armory near Dayton. This was one of several Guard units used to rescue stranded motorists and farm families in the Ohio area.

If you had asked a dozen hams living in the Illinois, Indiana, and Ohio area to define a blizzard on Wednesday, January 25, 1978, you probably would have been hard pressed to get a good answer. By noon the next day, however, that problem would have no longer existed—they were living through one!

The weather authorities say that this was the worst winter storm to hit the area since we began keeping records in the late 1800s. In Dayton, new records were set for lowest barometric pressure (28.66 in.), highest winds (68 mph), and most snow in a 24-hour period (12 in.), all accompanied by subzero temperatures. This, indeed, was a blizzard.

For the next 24 hours, virtually nothing that didn't have four-wheel drive could move in the region.

An area newspaper was headlined "Ohio Closed," and that probably summed it up best of all.

It was daylight Thursday morning before the full impact of the storm began to sink in. Due to the loss of electric power in large areas and the anticipated need to shelter stranded travelers, a massive relief effort was going to be required. Before these efforts were concluded, thousands of amateurs throughout the area would be involved in making the operation a success.

In the greater Dayton area alone, nearly 300 amateurs worked in around-the-clock shifts for four days, assisting the Red Cross in setting up and stocking shelters, dispatching four-wheel drive vehicles on rescue and transport missions, and handling health and welfare traffic to all parts of the country.

The majority of the communications were handled through the Miami Valley F.M. Association WR8ACV repeater systems on .04-.64 and .31-.91. The .04-.64 machine primarily functioned as a link for Red Cross shelter operations and was directed from a station at their headquarters in downtown Dayton.

The .31-.91 machine handled the bulk of the four-wheel drive vehicle dispatching, which was directed from a command post at the Centerville Police Department south of the city. A second station on .31-.91 at Red Cross coordinated their requests with the Centerville group.

Health and welfare traffic was routed locally through the Dayton Amateur Radio Association WR8ADP repeater on .34-.94 to several HF stations working the traffic nets. The D.A.R.A. machine also provided overflow capacity when the two primary machines were fully loaded.

The biggest problem faced by the amateur volunteers was simply getting to where they were needed. In some areas, amateurs living near shelters were picked up and transported by city or county snowplows. By late Thursday, satellite shelter communications had been established with Phillips-

Where's all your radio gear? That's what National Guard officers aked Stu K8ST when he and a Red Cross volunteer set up an emergency fuel-oil distribution system out of National Guard headquarters. The HT was all Stu needed to maintain contact with the Guard tank truck over a two-county area.

Roger W8LHL plants a two meter magnet-mount antenna on the roof of a four-wheel drive Blazer at Red Cross headquarters in Dayton. This was one of countless volunteer vehicles that were used to deliver food and supplies to shelters and otherwise inaccessible homes in the snowbound Miami Valley area.

Rick WB8WMY prepares to help a young man with an emergency supply of fuel oil for his family. Rick was one of a number of hams who rode the National Guard tank truck and helped with the oil deliveries, sometimes making as many as eight trips a distance of a quarter of a mile on foot to deliver the fuel.

burg, Brookville, Xenia, Englewood, Union, and Bellbrook.

Another serious problem was telephone service. By midmorning on Thursday, several telephone exchanges were so overloaded with either real or imagined emergencies that it became almost impossible to get a call through.

A similar problem existed on the Citizens Band channels. The local REACT group did a superb job of trying to help stranded motorists by dispatching CB-equipped four-wheel drive vehicles, but the QRM was unbelievable. Channel 9 sounded like channel 19 during rush hour.

By midday Thursday, the appeals broadcast by local radio and TV stations for four-wheel drive volunteers to report to Red Cross and area hospitals began to pay off. Several area auto dealers volunteered their four-wheel drive inventories to police and fire departments, and we began to team up hams with four-wheel drive operators.

Dispatches to transport nurses and doctors to and from area hospitals became commonplace. Many trips were made delivering prescription drugs and food to homes where these items were in critically short supply.

On Friday morning, the wind and snow began to subside, but road conditions had actually worsened from the day before. To relieve the radio traffic load at the Red Cross, the command post at the Centerville Police Department was established and coordinated with area hospitals to handle personnel shift changes. This operation continued through the afternoon of Saturday, the 28th, by which time most of the roads were at least passable for normal passenger cars.

During the day on Friday, the Red Cross operation took on added functions, as food and fuel-oil supplies began to run short in homes that were still cut off. Food deliveries in amateur-radio-equipped vehicles began on Friday and carried on through Sunday, the 29th. On Sunday, a separate fuel-oil delivery program was initiated using a National Guard tank truck dispatched by amateur radio from Guard headquarters. This service continued through the middle of the following week.

In retrospect, one of the most impressive aspects of the snow emergency was the high level of preparedness and adaptability displayed by amateur radio. Portable antennas and cigarette-lighter power plugs were in evidence everywhere, which made equipping four-wheel drive vehicles and National Guard trucks with two meter equipment relatively easy.

Rarely was there a lack of qualified volunteer radio operators. Indeed, the hardest problem at times was convincing some of them to get some sleep. Radio procedures were generally excellent, with short transmissions and rapid acknowledgements the rule rather than the exception.

The technical capabilities of the repeater systems really paid off, as well. Following the Xenia, Ohio, tornado in 1974, the need for a more reliable, better-coverage repeater system for the Dayton area became evident, and a system was designed. With the financial assistance of several local foundations and many hours of work by a dedicated technical committee, the system was installed and received its first real test under emergency conditions during the blizzard.

The machines performed flawlessly. With their saturation coverage of the two-county area of responsibility, hand-held portables and low-power mobiles were able to be used with an absolute minimum amount of time being spent on setup and installation.

Taken together, the combination of trained, willing amateur radio operators, flexible, properly-operating equipment, and a good, reliable repeater system was unbeatable for this situation. None of us had ever trained for an emergency like this—few would ever have expected a situation like this to occur. When the time came, though, the pieces fell into place, and ham radio went to work for the good of the community.

As one of my friends in the local REACT organization later told me, "I was listening on my police monitor, and you guys really sound professional. You sounded like you do that every day." That's about the nicest compliment I can think of.■

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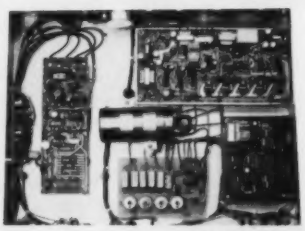

Under chassis view of SCR1000 with Autopatch installed.

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Jerrold A. Swank W8HXR
657 Willabar Drive
Washington Court House OH 43160

The Blizzard of '78

—a real snow job

At 2:00 am EST on January 26, 1978, the wind began to blow and the snow began to streak across the landscape, causing a whiteout that would do credit to an Antarctic winter storm. At 3:30 am, the furnace blower stopped and we lost our heat. The power had gone off all over Washington Court House. The loss of power knocked out both my two meter transceiver and the local 87/27 repeater.

Luckily, the power came back on in our section of the city at 8:30 am. Soon after that, I received a call from Paul Woods, the Deputy Director of the Disaster Services Agency, asking that I alert the ham radio emergency network. Since I am both the Disaster Services Agency Communications Officer and the newly-appointed Fayette-County Emergency Coordinator, it was my job to get the amateurs together. Although there had been no real advance planning, I made a call on the repeater for volunteers. The results were immediate and exciting. Many local hams had promptly gone to the repeater frequency. It was practically instant mobilization.

Eventually, twenty-six amateurs took part in our operation. We had a use for each of them — it certainly was a gratifying response.

Last year, the DSA director had depended on CBers, with very poor results. The emergency channel (9) was deluged with calls for the sheriff, and the other channels were loaded with people discussing the storm. High-powered amplifiers used by CBers in a nearby town on channel 10 caused so much adjacent channel interference that attempts to relay calls for help through CBers out of town failed. I had told him that next time I would show him what ham radio could do.

I asked first for someone to go to the DSA headquarters to set up a unit for communication with mobile units, as well as for quick connection with the office (since its line was also swamped with calls). To get in, I first had to wait several minutes for a dial tone, and then I would get a busy signal and have to start all over. The office could not call out, either. (The deep, drifted snow made it impossible for the telephone company to install lines, as had been done last year.)

Art Swadner WB8EEB said that he would go if someone would pick him up. Only four-wheel-drive vehicles could get through in most cases.

Since none of the DSA rescue people were hams, we had to have a mobile operator with each driver. Frank Johnson WD8OLN put about 300 pounds of old generators and radio equipment in the back of his Ford station wagon for ballast, and went after Art. He also volunteered for a mobile job, and even used his own car. Another volunteer, Mark Workman WB8TYC, needed transportation, so Frank picked him up. Bill Burns WA8IEJ also used his own car, and Mike Gray WA8HNS, Jim Turner WB8FTL, and Gary McCoy WD8LPK all became mobile operators to ride with the DSA rescue units.

The mobile units were designated DSA #1, DSA #2, and so on, so that the director, who was not a ham, would not have to remember ham calls. The mobiles indentified with both their call and with their DSA unit number. They handled more than fifty trips, either to bring in people or to take others medicine, food, or even fuel oil.

Jack McKirgan II WD8BNG handled messages via repeater relays for surrounding cities; there were about seventy-six messages handled.

I handled the telephone calls, and several Novices monitored channel 9 on the CB and called me for the phone calls to the sheriff. They also monitored our repeater on scanners, since they could not work two meter FM. This scanner/CB receiver method worked very well. I replied via 2 meters and they returned the channel

9 call with the information that they were going to be helped by either the sheriff or a wrecker, as the need appeared.

I had to dial the sheriff up to ten times to get a line. Each time, there was a wait of several minutes for a dial tone.

While we had offers of snowmobiles, the experience of last year taught us that they had limited usefulness. With a driver and a communicator, there was no room for evacuating people, and the intense windchill factor, due not only to the natural wind but also to the high speed of the snowmobiles, made it necessary that all occupants be warmly dressed. The four-wheel-drive vehicle is the real workhorse.

I averaged about four calls an hour, for over forty hours, and all this with only two hours sleep in the first twenty-four. This totalled more than one hundred sixty calls.

Gerald Ragland WA8BOB is a pharmacist at the local hospital, Fayette County Memorial. He was very active in the net, and also had to arrange for 3000 pounds of I.V. solution to be delivered from Dayton. The hospital administrator was so impressed with the smooth operation of the amateurs that the hospital is purchasing a two meter FM unit for future use, so that there will always be a unit there for emergencies.

Al Dixson WB8SRN also served at DSA headquarters, eventually being relieved by Jack McKirgan II WD8BNG. They were so pleased with Al Dixson that they have asked him to become a member of DSA. He has also been appointed Assistant Emergency Coordinator. He enjoyed being of service so much that it renewed his lagging interest in ham radio.

We did not, as some cities did, operate as a controlled net. Having everything funneled through net control may be necessary for large groups, but for a small one (26 active hams in the net), it would have been too slow.

Each ham did what he could do best, and all monitored the repeater. Several also were monitoring channel 9, and some were periodically reporting to other repeaters to get road and weather conditions. There are about a dozen repeaters in our range.

Each one knew at all times the entire story. I could drop out for lunch and someone would take my place until I came back. We notified the local radio station that messages for surrounding cities could be transmitted by telephoning Frank Johnson's number. He then gave them to Jack McKirgan II and they were passed on. We took no incoming health and welfare messages.

We learned a lot as we went along. For example, not to expect any road information from the sheriff or the state patrol, but to call the highway department. They plow and salt the roads, and know exactly what conditions are. We also realized the importance of having backup batteries for the 2 meter gear and the repeater, so that they are not "dead" when the power goes off. Extra flashlight batteries and a kerosene lamp or lantern should also be kept handy.

If you have an emergency generator, or anything else, be sure it is where you can get it. One ham had an emergency generator in his garage, but the garage door was drifted shut and so was his house door.

One ham lost his sixty-foot tower (which blew over), and his triband beam fell across the power line to his house. As a further irony, all his gear was away at the manufacturer's being serviced. All he had left was his phone. Even his 40 meter vee came down with the tower.

We were fortunate that Phil Brooks WD8DPI, who is a minister at the Grace Methodist Church, also had 2 meter FM available. He handled all the coordination of getting blankets, food, and other supplies, and arranging for the influx of stranded people who had to leave their cars in snowdrifts on the interstate. Four other churches cooperated, and the Red Cross furnished food orders when needed.

There were no messages received by us directly from CBers. The ones who were calling on channel 9 did not know at any time that they were being received by hams. The credit therefore went to the CBers, but both we and the CBers knew better.

The only time CB was used at all in any useful manner that we knew about was when a woman called the Red Cross here from Kansas City and wanted to know the whereabouts of her trucker husband, who had been bringing a load to a plastics company here and had not reported in some hours. I told the Red Cross that I would not undertake such a search with ham radio, but would turn it over to a CB club. I did this, and I heard several hours later that they finally located him at a motel.

Some people were even playing music on channel 9, but since most of this type of operation was in the city, we were able to have our outlying monitors copy calls. By contrast, in Wilmington, Ohio, 22 miles away, a REACT team operated with perfect discipline, and channel 9 was silent except for emergency calls. If you have such a well-operated CB group in your area, it would be well to make contact — otherwise, forget it.

There is great satisfaction in handling an emergency well, and it brings new pride in being a ham. Don't plan for any certain type of emergency. Everyone here thought that the most likely catastrophe was a tornado, after Xenia got hit. Then last year we had very low temperatures and freezing water pipes were a problem, as well as homes without heat and fuel. Still, one could get around, even to the grocery. Then this year a different type of storm hit. It was just plain snow — 26" of it, with high winds to blow it into drifts. No one could move. We could not even get to our car in the carport because of neck-high snow drifts. All roads into town were completely blocked. Snowplows bogged down and went into the ditch. If you didn't have something in your house, you did without it.

Even though our operation went smoothly, we are determined that the next emergency, with more planning, will involve more amateurs. We must have battery backup power for all the receivers, and must have a plan that will allow for efficient operation of our increased coverage and for helping other counties if they need help. We would like to be able to use CB units more effectively, and we would like for interested CBers to see how the ham system works. We also need a call-up system, in case the emergency is not as obvious to all as the snowfall was.

For experience, the Great Blizzard of '78 sure beat a Simulated Emergency Test.■

Alexander MacLean WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

How Do You Use ICs?

—part X

First, what is an ac clock circuit? It's a circuit that gives you a timing pulse keyed to the 60-cycle ac line frequency. This is accurate enough for many purposes, including, surprisingly enough, a number of the digital clock kits that are available.

The circuit performs one very important function. The ac line frequency is a 60-cycle sine wave. The digital circuitry runs on square-wave pulses.

Woe to the circuit that dumps sine waves into digital. They object. So there has to be a nice little circuit that will turn your sine wave into a digital signal.

I usually like to start off articles with examples of how easy it is just to steal the circuit you want from someone else's piece of equipment and use it for your own. Unfortunately, going through a number of back issues, I did not come across any line-frequency circuits published recently, so I will have to start off cold.

There was one type of ac circuit, though, which was quite common, and a simple method of designing this will be described.

There are two specific things the circuit must do to make the line frequency compatible with digital ICs. It has to convert it to a suitable voltage level, and it has to fool the digital ICs into thinking that it is a digital signal. This takes two different operations, each one of which is very simple. Refer to Fig. 1, which is the basic circuit.

There are many places in the equipment where you may be able to steal the ac voltage. The usual place is from an unused filament winding on the power transformer. You may even be able to couple it from the rectifier winding with a capacitor.

You do not need much current for the job – just an ac signal of sufficient voltage and no more. That is the function of R1. This may be a potentiometer, as shown, or two fixed resistors, or a combination of both. It depends on what voltages you have and what parts you may have.

The total resistance is a function of Ohm's Law. The only critical part is that the resistance should be high enough so that it does not draw appreciable current. A figure of five to ten mA would be a good start. Measure the available ac and figure the total resistance for current appropriate to the ratings of the resistors.

The next part is a little more tricky. You need the correct signal voltage to switch the 7400 gate. A look in a data book will give you a hint.

According to the data, you need a minimum of 2 volts to switch to high and less than 0.8 volts to go to low.[1] The maximum input voltage is listed as 5.5 volts. This gives you a ball-park figure, but it doesn't help all that much. That is a square-wave voltage, not the sine wave your meter is calibrated for. There is a simple way out, though.

That is how you get the voltage. Fig. 1 has a plain ordinary rectifier in the circuit. The output of the half-wave rectifier looks considerably like the pulse that it wants to a digital IC. Fig. 2 shows its waveform. Notice that it goes from zero to maximum and back again. The IC doesn't care that it hits zero instead of some low voltage state. It looks the same to the IC.

This makes it easier. Your meter will read a voltage even though it is not correctly calibrated. Simply start at no voltage from the resistor rectifier network and slowly increase the voltage to the rectifier until the IC starts pulsing. You can see it on a scope or a logic probe, or even on a meter. There will be a change in the voltage when the IC starts to pulse.

Go slowly and note the point at which the action starts. Then measure the voltage to the input to the IC. This will be in the few-volt range. Note the reading and then increase the voltage until you read ten or twenty percent more. This should give you some margin to take care of voltage variations.

As a final check, see that the new voltage is not too close to the stated maximum. It shouldn't be; mine wasn't. Then check again for correct switching action. If all is okay, you should be in business. The extra gate section

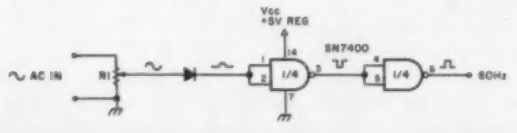

Fig. 1. Basic 60-Hz-sine-wave-to-60-Hz-square-wave circuit.

buffer is common in such circuits.

That is the simplest way to do it. When I was experimenting, I tried a few zener diodes in the circuit as the rectifier and to regulate the voltage. According to my meter, it didn't make all that much difference. The voltage across the diode never did reach its reference voltage. It did appear to have some smoothing effect when the voltage was increased, but it did not seem to be a significant factor in the circuit. Nor did it make much difference which way the diode was hooked up with either type of rectifier. It could be reversed or used with the diode across the IC instead of in series.

As long as the IC got the voltage, it appeared to work properly. For simple equipment, if I were going to use such a circuit, I would not bother with a more complex arrangement. I would try the simple way and see how it worked.

However, simple though this is, it does appear to be the hard way to do things. There ought to be some clever little gizmo that you can feed an ac signal into one side of so that a digital signal will pop out the other.

There is. It is called a Schmitt trigger. Its function is to turn an ac signal into a proper square wave, and it does a smoother job of it than the simple circuit.

Here we are blessed with a surplus of riches. There is not just one such device, but two — the SN7413 and the SN7414. There are some differences between them, but they can be easily fudged. The 7413 is really a dual 4-input NAND Schmitt trigger. The 7414 is simpler (Fig. 3) — just one input pin and one output pin. There are, however, six of them in the package, which is a lot of Schmitt triggers to play with.

The 7413 is a bit of a maverick. It is shown as a NAND gate with a Schmitt trigger following that and a NAND gate output stage. There is a Schmitt trigger in there somewhere, though. How you hook it up depends on how strong your stomach is.

From the pictorial (Fig. 4), it would look like the resistor rectifier combination should be used to feed it so that the NAND gate got a digital signal of sorts. I recollect that, when I was using them on the bench, I fed the sine wave directly to the input and got the square wave output just the same. My inclination would be to use the rectifier anyway, and just rely on the Schmitt trigger part for good smoothing of the output pulse. That way you get the best of both.

You can tie all four inputs together as you would with the unused inputs of the 7400, or you can tie the three unneeded inputs to the Vcc pin through a common 1000-Ohm resistor. Just remember that you will have to do something to account for all the inputs.

You determine the input voltage needed in the same way you do for the other devices, starting from zero and working your way up until the circuit works.

Often an extra NAND gate section of another IC is used as an output buffer for the 60-cycle stage in a fully built piece of gear. What comes after that? Usually two more simple stages (more if needed). A divide-by-six stage followed by a divide-by-ten stage[2] will give you a one-second pulse (Fig. 5). More divide-by-ten stages can be added if needed for slower timebases.

Fig. 2. Half-wave rectifier waveform.

There is a limiting factor to this circuit. It is so simple that you would think that everyone would want to add it to equipment because it is so easy, so there have to be some drawbacks.

One drawback is its frequency accuracy. The accuracy is only as good as the accuracy of the timebase, which in this case is the incoming ac line frequency. This is a nominal 0.05%. That sounds pretty good when you are just measuring a few seconds or so, but as you increase the time and start measuring fractions, you get problems.

To make it easy, think in terms of frequency. At 1000 Hz, 0.05% is not so bad — only 0.5 Hz. What's half a cycle to most audio use? At 10 MHz, it becomes 5000 Hz or 5 kHz, and, at 30 MHz, it becomes 15 kHz. When you hit the UHF frequencies, it Hertz even worse.

That's why you don't see too many frequency counters around with ac clock timebases. Even when you are measuring time, when you dig down into the microseconds, the accuracy is just not there.

There is one other common complaint with this circuit — ac line glitches. A glitch is not one specific problem, but a class of them.

They are the digital equivalent of gremlins. In this case, it is any extraneous pulse that manages to get in through the ac line. Machinery starting up in the area, stray electrical pulses, or static and lightning discharges, among other things, can cause a pulse on the ac voltage. This will come right in on the line and probably get right through the transformer primary and appear at the secondary.

The digital ICs are very sensitive and will happily follow any little pulse they see. This can give you a timing pulse that is out of time or phase with the 60-cycle frequency you want to establish. This actually is not that much of a problem with the counter-type circuit. It keeps updating its reading, and a stray counting error will be corrected at the next counting period.

However, in its normal usage, as the timing pulse for a digital clock, you have another problem. Once the timing error gets in, it stays in. There is no way the circuit can correct itself. That is why you see so many clock kits with crystal timebases and so many surplus crystal units giving 60-cycle output.

While the accuracy is much greater with the crystal unit than the ac line fre-

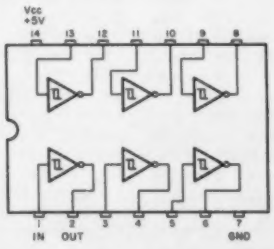

Fig. 3. SN7414 hex Schmitt trigger.

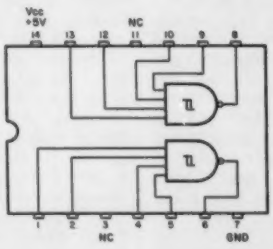

Fig. 4. SN7413 dual 4-input NAND Schmitt trigger.

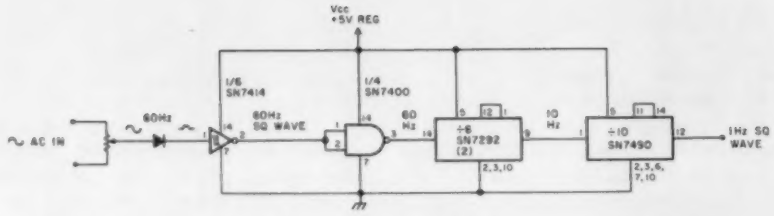

Fig. 5. 60 Hz ac timing chain.

quency, for most applications, the primary reason the crystal timebase is used is not for its accuracy but to divorce the timebase from the ac line, thus getting rid of the major source of timing error, the notorious glitch.

However, if all you want is a quick way to tell the time, or you need a quick and easy timing circuit, the ac line frequency timebase is hard to beat.

My recommendation would be the rectifier and 7414 combination with a 7400 buffer or an additional 7414 section buffer. That should be about the most reliable simple combination. ■

References

1. *TTL Data Book*, National (Radio Shack), February, 1976.
2. "How Do You Use ICs? – part III," MacLean, *73 Magazine*, November, 1976, p. 106.

LETTERS

from page 11

was the founder of International, and at one time held the amateur license W5EMH. He had not been active in amateur radio for the past several years.

Mr. Freeland was a pioneer in the manufacture of precision quartz crystals and frequency-measuring equipment. International was the first company in the United States to market a Citizens Band transceiver. The electronics industry would be put to task to find a person with a greater dedication to quality in manufacturing.

International will continue its operation in his tradition. Mr. Freeland's son, Royden WB5KDC, will be active in the company.

Bill G. Moore K5HTF
Russellville AR

GOVERNMENT BS?

Tell them all to go to hell—I like your way of thinking. I agree with your thoughts on government BS.

If I want to drive at 100 mph, I do so, as I have a 1971 Ranchero with a 375 HP Cobra engine which will do the job and I am not dead yet. I feel that the government has made these stupid regulations for the idiots that either cannot or will not learn about the safety rules of driving, and I feel that if they cannot drive safely, take away their driving privileges, not mine.

As far as this radar thing is concerned, the State of California is considering letting the CHP have radar. If they do, I shall proceed to purchase or build (ha) a receiver and then I will know where they are. I do not believe in jamming, but it is our privilege to receive. See you on 20.

Terry Downey W6TD
Bishop CA

SHOP AROUND

Okay, Wayne, this is in response to your request on working DX without going broke. I agree with Mr. Todd WB5SYP (June, 1978, issue) that ham gear today is beyond the reach of most of us. I, until recently, have been using a DX-60B Heath transmitter, a DX-150A Realistic receiver, and an old Johnson T-R switch with a low-pass filter. Total cost of this station is $230.00, including coax and a home brew 40 meter antenna. This setup has served me quite well and I have worked DX on many occasions. Almost all of the gear was acquired from want ads, hamfests, and local club activities. The whole trick is to *barter*, a term that is not dead. Of course, most of the operation here is CW and you will be quite surprised how long a conversation you can hold with 40 Watts output power. Remember one thing when working DX: Listen. Too many people on the bands today call CQ DX and then don't listen around. The art of patient listening was how I made my first QSO after passing my General test. It was with OY3H and he was using 100 Watts of power. There was a person next to me calling CQ continuously. Too much, in fact, to realize OY3H was there. However, after hearing me call and converse with OY3H just a few kHz away, he was next in line in the pileup that ensued after my QSO. What a feeling it is to answer a CQ from a semi-rare DX contact with only a few Watts and then sit back and chuckle at everybody else falling over each other trying to work the same station I had. In summary, there is quite a lot of good used gear around. You have to spend the time to survey your prospective gear and then barter for a satisfactory price. Don't tie yourself down to only one type of brand name gear. Shop around, that's the name of the game. Good things come to those who have patience.

Curtis D. Law WA2PIV/2
New Haven CT

TOO BAD?

A friend of mine left me the June issue of *73* to read because of the antenna info and, like a nut, I could not resist flipping through it. As always, I see that you have not changed in your attacks on the ARRL. Don't you ever get tired of writing about *QST* in *73*? Poor *73* cries like a second-rate cousin about her big sister, *QST*. I will admit to a passing weakness in looking at June's issue of *73*, but since you haven't changed and never will, I will continue to read about *QST* in *QST*, not *73*. You can keep your CB fans and gay advertisement for nets and your eternal gripes about the best ham organization (ARRL) around today. I can't figure out what keeps *73* afloat, except some people like to read articles that are critical of others. You are so hung up on the ARRL and *QST* that you have ruined what might have been a good mag, but it's too late now. Too bad. The ARRL haunts you like a bad dream that will not go away. By the way, you are right about one thing. Your attitude doesn't sell mags—it turns hams off.

Wayne Brandon WB5HMB
Garland TX

WARNING

The new regulations concerning linear amplifiers make me wonder if somebody slipped something in the FCC water coolers. It really makes good sense to clobber hams in the name of cracking down on illegal CBers. Suppose hams were getting on the 550-1600 kHz band—would the FCC ban the sale of broadcast band equipment? Probably! Why, they could carry that further—if drugs are smuggled into the country by plane, why not ban the sale of aircraft capable of international flights? Or maybe just the sale of suitcases.

While the heavy thinkers at the FCC were thinking up how to dump on hams, I took the Novice code test in early March. The 610 went in, but the written test didn't arrive until the end of April—weeks after I passed the General class exam on April 5th. After 10 weeks of waiting for my call letters, I called the FCC and was told to be patient—it could be another 8-12 weeks! Out of curiosity, I called my congressman (Rep. Stangland). His office discovered that my file was on "hold" and would remain there until action on my previous application (for Novice) was taken!! If his office had not called, I would have waited for months with nothing happening! Please warn other would-be hams. Another week and I would have wished I had put a CB between channel 40 and the

Continued on page 104

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—your antenna wire

With few exceptions, almost everyone up till now has experienced the curse of kinks in copperweld antenna wire. Number 14 gauge copperweld consists of a steel core and an integral copper jacket, approximately 30 percent copper by weight. As the wire is drawn down to size, it becomes work-hardened and springy. When wound into the fifty-foot continuously connected coils in which it is stocked and sold, it is in a stressed state. Do not remove the ties from a fifty-foot coil and let it drop unless you wish to be confronted with a minor demon in the form of a tangle of wire which is most difficult to tame. (Amen!—ed).

An interesting experiment was once performed by an electrician friend who carefully tied one end of two fifty-foot coils to a power pole in his backyard and carefully unrolled the one hundred feet of copperweld which he attached to the bumper of his car. He then let the car roll a short distance down the sloping driveway to "stretch and straighten" the wire, when it suddenly snapped at the bumper and wrapped itself around the pole in an impossible mess. He cut the wire into short lengths, disposed of them in the trash, and went to his supplier for more wire.

By following the instructions given below, you can unroll and straighten copperweld so that an antenna can be strung without the kinks, snarls, and uncouth comments commonly associated with the devilish stuff. To accomplish this minor miracle, proceed as follows:

1. Determine the length needed and purchase (or cut off) sufficient fifty-foot coils for the job at hand.
2. Hold one coil securely so that the many turns cannot flip out of the plane of the coil, and remove all of the ties from that one coil.
3. Carefully permit the coil to relax and expand in your hands, with assistance as required, until the stored stress is relieved.
4. Retie the relaxed and expanded coil.
5. Repeat steps 2, 3, and 4 for each coil.
6. Make a simple wire straightener from scrap wood as shown in Fig. 1. The guide holes are just big enough to pass the wire. One block is fixed and the other is pivoted on one screw and then clamped when properly adjusted.
7. Place the coils as shown. Insert a short length of wire from the bottom coil through the guide holes, and then remove the ties from the bottom coil.
8. Pull about three feet of wire through the straightener device, making necessary adjustments to the movable block.
9. Tie the end of the wire to a solid anchor point, such as a tree, post, or antenna mast, and back away in such a manner that you control the rotation of the coils and keep them flat against the board.

You should now have your copperweld lying across the yard with only a slight waviness—provided your adjustment was correct. The straightener works by bending the wire in the opposite direction from that in which it was coiled, just enough to leave the wire in a reasonably straight condition. Now you can get on with the routine business of putting up your antenna with manageable ease. ■

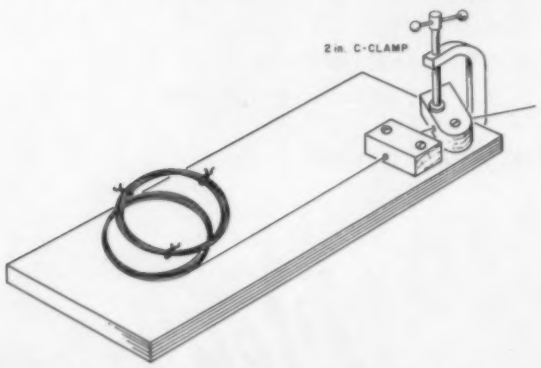

Fig. 1. Wire straightener construction: base—1/2" or 3/4" plywood; guide blocks—1" × 1" × 2" pine. Nail or screw to base.

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Nuclear Attack!

—WWIII on your SR-52

Dan Everhart WA7WKA
293 Lander Hall
University of Washington
Seattle WA 98105

Uh-oh, here's another violent and destructive computer game. And it uses nuclear weapons, yet, in this age of detente. I'll bet Texas Instruments never dreamed that their SR-52 would be used to stage World War III battles. Read on, and see how to make yourself a world power! If you don't like the game, at least you may pick up a couple of interesting programming tricks for the SR-52.

The game itself is a new twist on the old "sub search" type of game. Most people get sick of sub searching after a few games, because the game isn't really challenging. It's a simple matter to narrow down your coordinates with each shot, and the game becomes a sort of three-dimensional high-low. The twist in this game is that you are shooting at more than one target at once (six in this version), and you have to be a lot

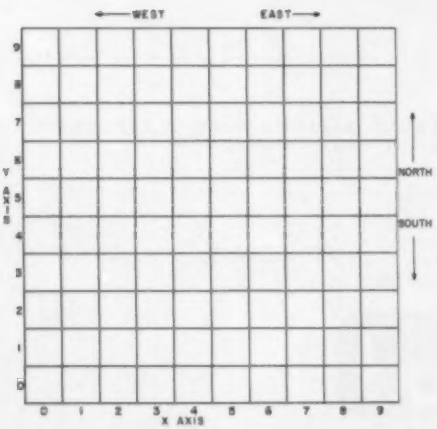

Fig. 1. This is how the board is set up. It represents your enemy's missile base.

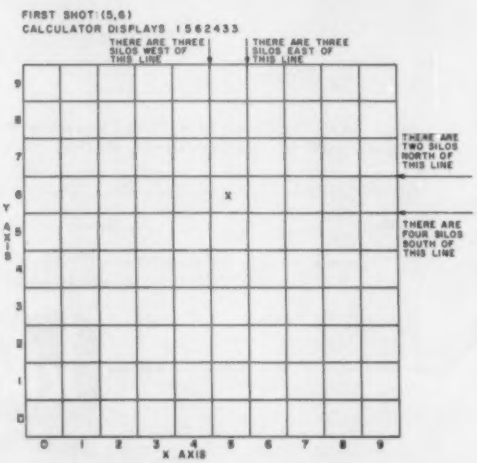
FIRST SHOT: (5,6)
CALCULATOR DISPLAYS 156243
THERE ARE THREE SILOS WEST OF THIS LINE
THERE ARE THREE SILOS EAST OF THIS LINE
THERE ARE TWO SILOS NORTH OF THIS LINE
THERE ARE FOUR SILOS SOUTH OF THIS LINE
Y AXIS
X AXIS
0 1 2 3 4 5 6 7 8 9

Fig. 2. Diagram of example used in text.

more clever to figure out where they are.

How To Play

For equipment (besides the calculator), you will need a pencil and a sheet of paper marked off into one hundred squares in a ten-by-ten array. This sheet of paper represents your enemy's military base which you are attacking. You don't have to use this paper diagram, but, without it, keeping track of your play is nearly impossible. The columns are numbered 0 through 9, from left to right, and the rows are numbered likewise, from bottom to top (Fig. 1). In this way, the board could be looked at as the first quadrant in an x-y plane, so I will refer to the west-east direction as the x-axis and the north-south direction as the y-axis.

Your enemy has six ballistic missile silos hidden at random on this base. You, on the other hand, have a remotely-controlled offensive weapons satellite from which you can drop guided nuclear bombs upon the enemy base. You input the coordinates of the square upon which the bomb is to fall. It is your task to destroy all six silos using as few of your bombs as needed. The only information you are given is the number of silos that lie to the north, to the east, etc., of each bomb you drop. How well you do depends on your skill at organizing and interpreting this information. There is no upper limit on the number of shots you may take.

Each time you load the program, you will have to enter a seed for the random number generator that locates the silos at the beginning of each game. Enter your number and press A. You can use the time of day, your age in minutes, the Dow-Jones average, whatever. I usually just hit the decimal point and then seven or eight digits at random. Any number between 0 and 10^9 will work (except the number one—the random number generator chokes on the number one).

To start the game, press B. The calculator will take about thirty seconds to randomly locate the six silos and will display a zero when ready. You need only randomize once for each series of games you play. Each successive start will give a different pattern of silos.

Now select which square you want to bomb first (example: 5,6—five is the west-east, or x-, coordinate, and 6 is the north-south, or y-, coordinate). Press 5 and then D to enter the x-coordinate, followed by 6, then E to enter the y-coordinate and run the program. Congratulations, you have just destroyed everything within square 5,6. And you didn't even have to file an environmental impact statement! After about 25 seconds, the calculator will come back with a confusing string of digits, like 1562433. Let's break this display down digit by digit and explain what it means.

Taking the digits from left to right, the first digit, 1, means shot number one. The next two digits, 56, are an echo of which square you bombed. The next digit, 2, means that there are two silos to the north of this shot. This doesn't necessarily mean that they are directly north along the same column, but *only that their y-coordinates are greater.* This is a major point of confusion among new players (see Fig. 2). The remaining digits are similarly south, east, and west, respectively.

Wait a minute! The example says 2433. That adds up to twelve silos. Is there a bug? No, each silo counts twice—once as being either north or south of where the bomb was dropped, and again as being either east or west. Note that, if a silo lies along the same line as your shot, it won't show up in either of the two indicators for that direction. In other words, a silo on the same vertical column as your shot counts as neither east nor west, and one along the same horizontal row counts as neither north nor south.

When you hit a square that contains a silo, the display will flash. Press CE to stop the flashing. When a silo is hit, it is destroyed and will not show up on subsequent shots. Although it doesn't happen very often, two or more of the silos may be placed in the same square. When this happens, they are both destroyed when the square is bombed.

When the last silo is hit, the last four digits will be 0000, and the game is over. To start a new game, press B.

Different people have come up with different strategies for this game, and I will leave you to find your own. Among people I know, the best players average about thirteen shots per game. The record low at this writing is eight bombs. However, at the other end of the spectrum, I saw one person give up after fifty shots. That base must have really been smoking!

About the Program

Writing a program for a programmable calculator is very different from writing a program in microprocessor assembly language or a higher level language such as BASIC. The greatest disadvantage of the programmable calculator is its small amount of program memory. The simplicity of pushing each key to enter its function into the program makes coding a program, say from a flowchart, very simple and straightforward. However, a more complex program will need more keystrokes than there is memory to hold them when using the straightforward approach. So the programmer must resort to tricks to condense the program to a usable size. The trade-offs involved with these tricks are: (1) They make the program harder to debug and harder for someone other

Register	Contents
99	random seed
19	number of shots taken
18	x-coordinate of shot
17	y-coordinate of shot
16	number of silos north of shot
15	number of silos south of shot
14	number of silos east of shot
13	number of silos west of shot
12	silo #1 x-coordinate
11	silo #1 y-coordinate
10	silo #2 x-coordinate
09	silo #2 y-coordinate
08	silo #3 x-coordinate
07	silo #3 y-coordinate
06	silo #4 x-coordinate
05	silo #4 y-coordinate
04	silo #5 x-coordinate
03	silo #5 y-coordinate
02	silo #6 x-coordinate
01	silo #6 y-coordinate
00	dsz and pointer

Fig. 3. Register usage table.

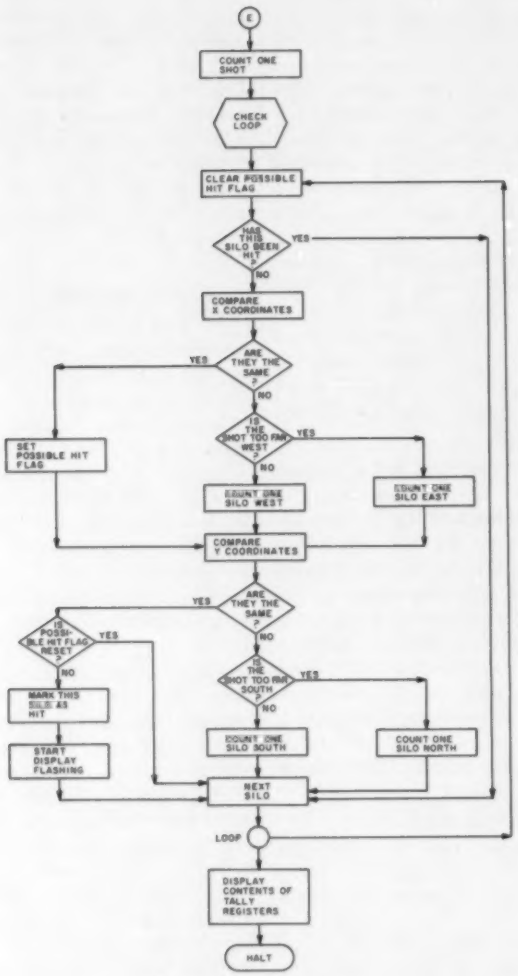

Fig. 4. Flowchart.

than the programmer to understand, and (2) they usually slow the program down. So, as vital as informative remarks and good documentation are for regular programs, they become even more important for the programmable calculator's programs.

In this game, the x- and y-coordinates of each silo are stored in registers 01 through 12 (see Fig. 3). When a game is started by pressing B, 12 is stored in register R_{00}, which is used as a pointer. The program generates a random digit, which is stored in the register pointed to by R_{00} using an IND STO instruction (step 197). The IND key is one of the most useful programming functions on the SR-52. It tells the calculator that it is to perform the memory function immediately following the IND (STO, RCL, EXC, SUM, etc.), not on the register specified in the instruction, but on the one whose number is stored in that register. For example, if R_{00} contains the number 9, then the command IND STO 00 would perform the same function as STO 09: The displayed number would be stored in register 09.

Using the dsz instruction (decrement and skip or zero) after each random number is stored, the program decrements the value in R_{00} by 1 and checks to see if it has reached zero. If it hasn't, the program loops back to LBL *7' and repeats the process. So, effectively, the first time through, the loop R_{00} contains 12 and the IND STO 00 stores the random digit in R_{12}. The next time through, R_{00} contains 11 and the random digit goes in R_{11} and so on. When R_{00} finally reaches zero, the dsz doesn't cause a branch, but just lets the program continue and halt. Now R_{01} through R_{12} each contain a random digit, and these are the coordinates of the silos (Fig. 3).

The Silo Shuffle

The random number generator (steps 179-196) has its random seed stored in register 99. This is because R_{99} and R_{98} are surplus registers which are unaffected by the CMs instruction which clears R_{00} through R_{19}. The seed is recalled, Inxed, and then squared and stored back in R_{99} as the new seed. This number is multiplied by the degrees/radians constant (57.295779513) and the part to the left of the decimal is chopped off, leaving a decimal fraction. The decimal is multiplied by ten, and the digits to the right of the decimal are removed, leaving an integer from 0 to 9. This approach can be modified to produce random integers from zero to N by replacing the multiplier of 10 in step 193 with a multiplier of N+1.

Pressing D stores the x-coordinate of your shot in R_{18}. E stores the y-coordinate in R_{17} and continues on to the main body of the program.

Each silo is checked individually. First the xs are compared by subtracting the shot x from the silo x. If the result is zero, then that means that the shot and silo are on the same column. Flag zero is set when this happens so that the calculator will remember later in the program that the xs were the same in case the ys are the same, too, which would mean a hit. If the difference between the x-coordinates is positive, then the silo x was greater than the shot x, and the shot must have fallen to the west of the silo, so R_{14}, which contains the number of silos to the east, is incremented by one. If the difference is negative, then the opposite is true, and R_{13} (west) is incremented instead.

Now, since we are using R_{00} as a pointer to tell which coordinate of which silo we are working on, we must decrement it by one to get to the y-coordinate. We do this with a dsz command that branches just ahead of itself. The same procedure as was used on the x-coordinates is applied to the y-coordinates, except that now, if they are the same, we must check to see if flag zero is set. If it is, then both silo coordinates match the shot coordinates, and we have a hit. When a silo is hit, the program changes its x-coordinate to -1 as an indicator that it has been hit and is to be skipped over on later shots. Then a $\sqrt{x}$ establishes an error condition so the display will flash when execution is completed. If the y-coordinates are not the same, then, like before, the north register or the south register is incremented, depending on which side of the silo the shot fell.

Now another dsz instruction loops back to the beginning of the check procedure and moves the pointer to the x-coordinate of the next silo, or, if there are no more silos to check, passes control on to the display routine.

The display segment demonstrates a useful way to display the contents of several registers at once. Again R_{00} is used as a

pointer, but this time it starts at 19 and is decremented until it reaches 13, and the program halts. The calculator keeps a running total of the contents of each register times a decreasing power of ten. Thus we get $(R_{19}) \times 10^6 + (R_{18}) \times 10^5 + \ldots + (R_{13}) \times 10^0$. Each register contains only a one-digit number, so the resulting sum is a number made by stringing together the contents of registers 19 through 13. Of course, the proper things are stored in each register in order to have the display come out in the order we want.

For the Sake of Speed

Looking over the program listing, you may be wondering about the strange order in which the segments of the program are arranged in memory. The user-defined labels are near the end, and the program branches and subroutines come before the program. The best way I can answer this question is to have you try the following experiment:

Run the four programs in Fig. 5, and time the execution using the second hand of a clock or a stopwatch. Make sure you turn the calculator off to clear the program memory before entering each program.

You can see that the four programs do exactly the same thing. They only differ in their locations in memory and their dsz instructions. Two of them are labeled branches, and two are directly addressed. On my calculator, all programs run in about ten seconds except number two, which takes more than forty. It seems reasonable to me to assume that, when the calculator is told to branch to a particular label, it must search through the program memory starting from the beginning. Naturally, the farther down in the program memory a label is, the longer the calculator must take to find it and the slower the execution will be. In program one, the sought-after label B is almost at the beginning, so the calculator finds it quickly, and the loop executes swiftly. In program two, however, the machine must seach through almost the entire memory before it locates label B. Consequently, this loop takes

Step	Keystrokes	Comments
000	*LBL *1'	
002	*dsz *8'	Skip this silo.
004	*LBL *2'	
006	*st flg 0	Set the "possible hit" flag.
008	GTO *5'	
010	*LBL +	
012	1 SUM 14	Count one silo east.
016	GTO *5'	
018	*LBL *9'	
020	1 SUM 16	Count one silo north.
024	GTO *8'	
026	*LBL *3'	
028	INV *if flg 0 *8'	If flag set, then we have a hit.
032	1 SUM 00	Change x-coordinate
036	± *IND STO 00	of silo to -1.
041	*√x *dsz *8'	Start display flashing.
044	*LBL *B'	Integer-part subroutine.
046	(STO - . 5)	Subtract rounding constant.
052	*fix 0 *D.MS	Eliminate fractional digits.
055	*rtn	
056	*LBL E	
058	STO 17 CE	Store y-coordinate of shot.
062	1 SUM 19	Count one shot.
066	0 STO 16 STO 15 STO 14 STO 13	Clear N.,S.,E.,W. registers.
079	12 STO 00	Initialize check loop.
084	*LBL *4'	Beginning of loop.
086	INV *st flg 0	Clear "possible hit" flag.
089	*IND RCL 00	Get x of silo.
093	INV *if pos *1	Branch if it's been hit.
096	- RCL 18 =	Compare to x of shot.
101	*if zro *2'	If same, set flag.
103	*if pos +	If greater, count one silo east,
105	1 SUM 13	else count one silo west.
109	*LBL *5'	
111	*dsz 115	Move to y-coordinate.
115	*IND RCL 00 - RCL 17 =	Compare silo y to shot y.
124	*if zro *3'	If same, check for hit.
126	*if pos *9'	If greater, count one silo north,
128	1 SUM 15	else count one silo south.
132	*LBL *8'	
134	*dsz *4'	Branch back if more silos.
136	20 STO 00 0	Initialize display loop.
142	*LBL *6'	Beginning of loop.
144	+ *dsz 149	Move to next register.
149	*IND RCL 00 X 10 y^x	Get contents of this register and
157	(RCL 00 - 13)	multiply by decreasing powers of ten.
165	INV *if zro *6'	
168	= HLT	
170	*LBL B	Begin new game.
172	CLR CMs	Clear everything.
174	12 STO 00	Initialize setup loop.
179	*LBL *7'	Beginning of loop.
181	RCL 99 Inx *x^2 STO 99	Make a random digit
189	INV *D/R - *B' X 10 = *B'	from 0 to 9.
198	*IND STO 00	Store it as a silo coordinate.
202	*dsz *7'	Branch back for the next one.
204	CLR HLT	Ready to play.
206	*LBL A	
208	STO 99 HLT	Store initial random seed.
212	*LBL D	
214	STO 18 HLT	Store x-coordinate of shot.

Program listing.

much longer to execute. In programs three and four, the branches are made directly to a specified address. The calculator doesn't have to waste time searching, because it has been told exactly where to put the program counter. Thus, both of these loops execute quickly no matter where they are placed in program memory.

As I said, this explanation is an educated guess on my part, and perhaps someone who knows what goes on in the mind of a TI calculator will write in and clarify this point.

Anyway, this is the reason for placing the branches and subroutines before the main program—the closer they are to the beginning of program memory, the faster the calculator can find them and the faster the program will run. It does make the program more confusing to look at, and I don't recommend that you try to write your programs this way. But, when you finish a long program and have it running, you may find that rearranging things will speed it up considerably.

Go, Team, Go

The game was popular enough in the dorm where I live that we decided to hold a tournament. Each contestant would play three games and total his scores, lowest score winning. To make things fair, each person would play the same three configurations of silos. This was accomplished by randomizing with the same initial seed before each game. For example, we used sin 1, sin 2, and sin 3. The random number generator then generates the same sequence each time, and the silos come out in the same spots. I find that it's handy to write down the number you initialize with anyway. That way, if the system crashes (batteries go dead), it's simple to set the same game up again after plugging in the charger. It's really frustrating to lose a game half way through, especially when you were just about to blast a silo.

And you certainly don't have to be a computer buff to enjoy the game. My roommate won the tournament—he's a political science major! ■

step	keystrokes		
Program one		**Program three**	
000	*LBL A	000	*LBL A
002	100 STO 00	002	100 STO 00
008	*LBL B	008	*LBL B
010	*dsz B	010	*dsz 008
012	HLT	014	HLT
Program two		**Program four**	
200	*LBL A	200	*LBL A
202	100 STO 00	202	100 STO 00
208	*LBL B	208	*LBL B
210	*dsz B	*210	*dsz 208
212	HLT	214	HLT

Fig. 5.

LETTERS

from page 96

10 meter band, at a kW, and worked the world with no hassle by the FCC!

Please, Wayne—don't say anything sarcastic or derogatory about the FCC until my call letters come. Maybe the truth hurts and they become even more vindictive. I hope there will still be some frequencies left for hams by the time I can go on the air!

Walter Kimmel
Ponsford MN

FORGET ABOUT THIS ONE

Enclosed is the renewal form you sent me for renewal to your magazine. While I like your magazine very much, there are certain things that I cannot tolerate. I now take all the ham magazines, *QST*, *CQ*, and *Ham Radio*; I am a life member to *QST* and have all the rest paid for until 1981.

Now, all four magazines are real good magazines, and I like them very much. But up to this point, I have yet to hear one of them badmouth your magazine, but every month, and I do mean every month, you have your nasty snide remarks about them. I don't like it; it is the act of a 3-year-old child, to say the least.

There is nothing I can do about it, but I don't have to sit here and read it, so just forget about this renewal. When you grow up into a grown man, I might consider renewal.

Just remember, Mr. Green, the other magazines are just as good as yours, and that is supported by a lot more opinions than mine.

I hold no magazine rating over the top of the other one. I don't hold *QST* over *73* or *73* over *QST*. I read them all with interest and really learn a lot from them all.

It is your magazine; run it the way you want, as I know you will. But remember, it takes customers to keep it going. Look at the renewals you did not get and ask yourself why you did not get them.

Carl Manion W4BDC
Shepherdsville KY

. . . AND THIS ONE

I'll be only too happy to renew my subscription to *73* as soon as Wayne recovers from his total fascination with microprocessors et al, and begins to print stories on some other aspects of amateur radio again!

Bob Kuehn WØHKF
Saint Paul MN

LET'S DO SOMETHING!

Wayne, is there anyone who can represent the hams and let their desires be known? The ARRL does not and will not represent anyone but the ARRL. You've pretty well said it all in your editorials. I feel that if we keep sitting on our duffs, we will have exactly what the ARRL would like for us to have—nothing! The "Spark Forever" boys in Newington are too busy making a buck. Wonder if they've heard of micros yet? The point is, if you are willing to accept the ambassadorship, I'm willing to donate ten bucks to the cause and I would bet a large percentage of your readers would do likewise. Why not ask them and get a campaign started? At any rate, let's do something!

Jim Best WAØRZI/4
Woodbridge VA

KA CONFUSION

I am writing on behalf of the members of the Far East Auxiliary Radio League (FEARL) and all others assigned callsigns with a KA prefix to request your assistance in disseminating information on a problem we are having here in Japan.

Since shortly after the close of World War II, U.S. Forces personnel in Japan have been issued callsigns prefixed with KA. KA callsigns in Japan are issued by the military authorities in a 2 x 1, 2 x 2, or 2 x 3 format, and there are currently authorized stations assigned KA1, 2, 3, 5, 6, and 8 prefixes with the possibility of KA areas

Continued on page 124

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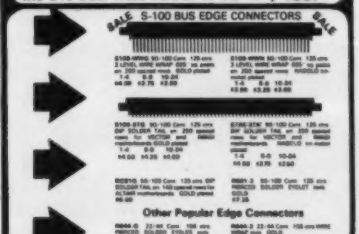

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3 LEVEL GOLD WIRE WRAP SOCKETS

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8 pin*	.41	.38	.35	.31	.27	.23
14 pin*	.39	.38	.36	.32	.29	.27
16 pin*	.43	.42	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.42	.36
20 pin	.80	.75	.70	.63	.58	.53
22 pin*	.90	.85	.80	.70	.61	.57
24 pin	.90	.84	.78	.68	.63	.58
28 pin	1.10	1.00	.90	.84	.76	.71
40 pin	1.50	1.40	1.30	1.20	1.04	.89

Sockets purchased in multiples of 50 per type may be combined for best price.

All sockets are GOLD 3 level closed entry * End and side stacable. 2 level, Solder Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector

- Kit includes 12 tantalum capacitors for +5, +12, —12 buses and mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 buses, copper, solder plated and .039 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R881-2, or mounts 10 receptacles plus edge connectors to smaller mother board for expansion.
- Includes etched circuits and instructions for space-saving, pull-up, or floating terminations.
- Large buses: +5V and GND (10 AMPS), ± 12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise.
- Fits in Vector-pak enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.

Price: $29.50

Vector Plugboards

8800V

Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.95

8801-1

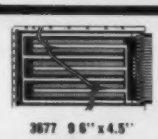
Same as 8800V except plain, less power buses & heat sink.

1-4	5-9	10-24
$14.95	$13.45	$11.95

3602 9.6" x 4.5" $10.97

3602-2 6.5" x 4.5" $9.81

Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5" $10.90

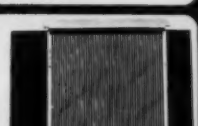
3677-2 6.5" x 4.5" $9.74

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

3662 6.5" x 4.5" $7.65

3662-2 9.6" x 4.5" $11.45

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156



3690-12 CARD EXTENDER

Card Extender has 100 contacts-50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems..... $25.00

3690 6.5" 22/44 pin .158 etrs. Extenders..... $12.00

1/16 Vector BOARD .042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1 - 9	10 - 19
64P44XXXP	4.5x6.5"	$1.49	1.34
169P44XXXP	4.5x17"	$3.51	3.16
Epoxy Glass			
64P44	4.5x6.5"	$1.70	1.53
84P44	4.5x8.5"	$2.10	1.89
169P44	4.5x17"	$4.30	3.87
169P84	8.5x17"	$7.65	6.89

SLIT-N-WRAP

Wraps insulated wire on .025" square posts

FOUR TIMES FASTER than regular manual wrap post tools

P180 with two 100" spools of 28 ga. wire

$24.50

P109-4T includes charger, wire

$75.00

Vector

NO PRE-STRIPPING* NO PRE-CUTTING* SPOOL-FED WIRE*

*This spooled wire passes through the tool post a slitting edge next to the wrap post. A narrow longitudinal cut is made on the insulation where it crosses the square post corner. The buried copper is indented by the sharp edge. (7 turns in 20 corners)

"Easy-chain" runs foldable and easy to use manual or power operation

SLIT-N-WRAP WIRE NO. 28 GAGE INSULATED WIRE, 100' SPOOLS

*2" Package

2708 8K 450 ns EPROM FACTORY PRIME $10.00 EA. 25 + Call For Price

WOW 14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKETS

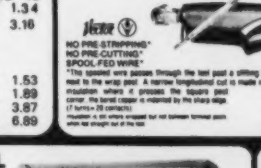
14 - G3 100 for $30.00

16-G3 100 for $30.00

50 of each for $32.00

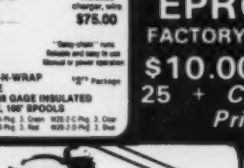
Sockets are End & Side stackable, closed entry

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR



- For Auto, Home, Office
- Small in size (2x2½x⅝)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE. LCD-101, portable model runs on self-contained batteries for better than a year. LCD-102, runs on 12 Volt system and is back-lighted.
- LCD-101 or LCD-102 your choice $34.95
- Clear desk stand for $2.00

LEDU MG 10A List $72.

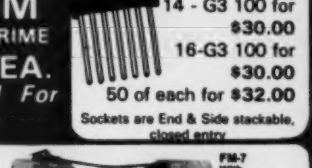


Perfectly balanced, fluorescent lighting with precision magnifier lens. For profit, techn'l & hobbist. Has die cast protective shade, mod. start 3 diopter lens, 42" reach.

$44.95

with 7.5 fluorescent lamp required) GM-36 colors: Gray or Black Chevrons Brown 2 choices shown

$44.95 SPECIAL



BC-5 With Rechargeable Batteries & Charger Unit $98

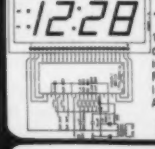
FM-7 With Rechargeable Batteries & Charger Unit $215

Features Include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 60 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit readout. • The FM-7 can be calibrated to an accuracy of 0.0001%. • The SC-5 is accurate to one part per million. • Each unit has 30 millivolts sensitivity, is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" L. • The two units may be obtained separately or as a "Frequency Duo. • Parts & Labor guaranteed 1 year.

TIR stand option ..... $ 3.50
Leather case $20.00

MICRO-KLIP for .042 dia. holes (all boards on this page)

T42-1 pkg. 100 $ 1.50
T42-1 pkg. 1000 ..... $11.00
P-149 hand installing tool ..... $ 2.00



.8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3½ digit .8" LED Display with AM/PM indicators and colons. Direct drive. PIN to PIN interface with MM5316A I.C. Just add switches, AC Supply, Alarm. Display and I.C. only.

$7.95 or 2/$15.00

1

Price Breakthrough! $17.50

MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL

14CS2 100 for $14.95
16CS2 100 for $16.95
14 pin CS2 10 for $2.00
16 pin CS2 9 for $2.00

These low cost DIP sockets will accept both standard width plugs and chips.

For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

WRAP POST for .042 dia. holes (all boards on this page)

T-44 pkg. 100 ..$ 2.39
T-44 pkg. 1000 ..... $14.00
A-13 hand installing tool ..... $ 2.00

P21 PRIORITY ONE ELECTRONICS ©

4911S West Rosecrans, Hawthorne, CA 90250

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00. Orders less than $75.00 include 10% shipping and handling; excess refunded. Just in case . . . please include your phone no. "Sorry, no over the counter sales" Good thru Sep. 1978

Send for our latest brochure. phone orders welcome (213) 973-4876 OEM and Institutional inquiries invited

24 PIN DIP PLUGS WITH COVERS

3 / $1.00
40 / $10.00

NLS MS-215 DUAL TRACE MINISCOPE $435.00

FREE PROBES FREE PROBES FREE PROBES

Charles Zappala WA7VZR
8051 N.E. 143rd
Bothell WA 98011

Computerized QSO Records

—*who needs a logbook?*

Well, enough already of computer games – let's get down to serious application programming! I've always wanted a computerized log and inquiry system to rid me of trying to relate callsigns to names . . . "Gee, that call is familiar. Did I work him before? What's the handle? QSLs? Aw, rats! What's the handle, old man?"

This program (Fig. 2) will take care of all those questions. It will allow you to quickly enter log entries by using data statements beginning at line 1000. The end-of-data file is indicated as DATA 999999, as shown at line 1005. You can have as many data lines as your memory can hold. In the inquiry mode (RUN), the program will print out (display) log entries by date, callsign, or just print out all of the entries, by entering its function number.

To add log entries, type in function 1 and a LIST function starting at line 1000 will begin and take you out of BASIC. This will allow you to change the DATA 999999 line to a log entry. The DATA format is: (line number) DATA (year, month, day), (time), (callsign), (frequency), (mode), (power), (QSL), (QTH-name).

Note that "QTH" and "name" share the same data item definition.

Note that the date must be entered as YYMMDD (year, month, day). I'll explain why soon. After the entries are made, add (line number) DATA 999999 to end the data file. Type RUN again to begin the program.

Function 2 selects log entries for printing by entering two dates in the YYMMDD format. What comes out is all log entries between and including the dates specified. The logic is located in line 416. With the YYMMDD format, dates run in ascending numerical order, which makes the logic just plain simple.

Function 3 selects log entries for printing by entering a callsign. What comes out is every log entry for that callsign. The logic is very simple and is located in line 510. Function 4 prints out all the log entries.

By using subroutines to

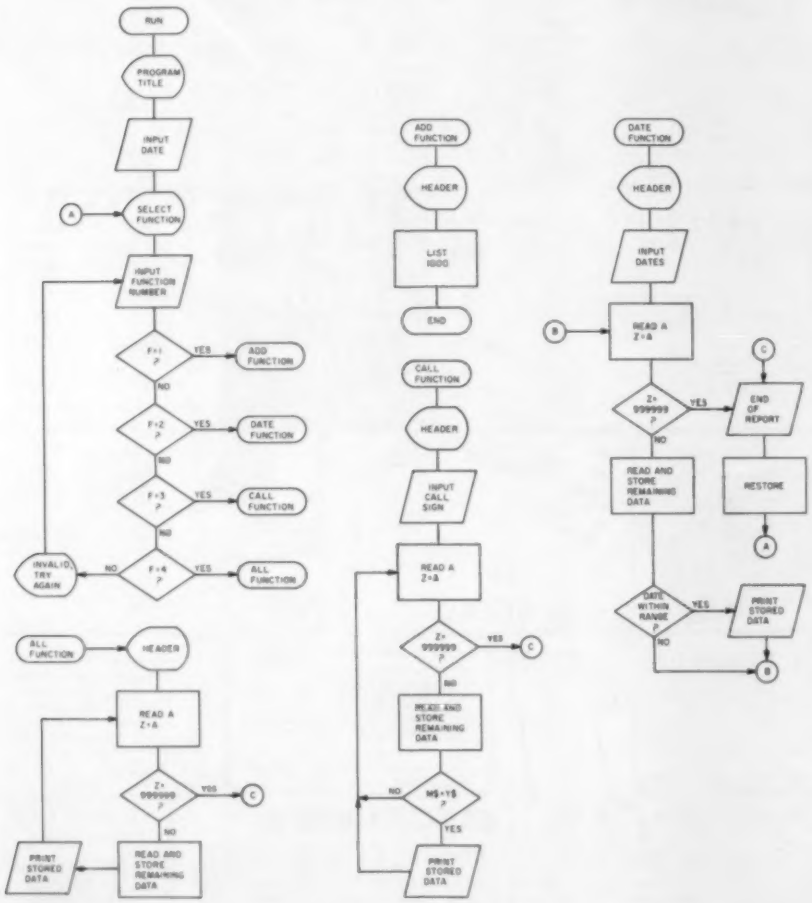


Fig. 1. System flowchart.

```
LIST

10 REM ************ AMATEUR RADIO LOG AND INQUIRY SYSTEM ************
11 REM                          BY COMPUTER
12 REM WRITTEN BY CHUCK ZAPPALA WA7VZR 8651 NE 143RD BOTHELL WA 98011
13 REM
14 REM THIS PROGRAM IS RELEASED TO PUBLIC DOMAIN              MAY 1977
15 REM
16 REM VERSION 1.0     WRITTEN IN ALTAIR 8K BASIC VERSION 3.1
17 REM
18 REM ************************************************************
100 PRINT:PRINT"AMATEUR RADIO LOG AND INQUIRY SYSTEM":PRINT
102 PRINT:INPUT"ENTER TODAY'S DATE (YYMMDD)";D:PRINT
105 PRINT:PRINT"SELECT ONE OF THE FOLLOWING FUNCTIONS":PRINT:PRINT
110 PRINT"   1. ADD LOG ENTRIES"
115 PRINT"   2. PRINT LOG ENTRIES BY DATE"
120 PRINT"   3. PRINT LOG ENTRIES BY CALL SIGN"
125 PRINT"   4. PRINT ALL LOG ENTRIES"
145 PRINT:INPUT"ENTER FUNCTION NUMBER";F
160 IF F=1 THEN GOTO 300
165 IF F=2 THEN GOTO 400
170 IF F=3 THEN GOTO 500
175 IF F=4 THEN GOTO 600
200 PRINT"INVALID. TRY AGAIN":GOTO 145
300 REM ADD LOG ENTRIES
302 PRINT:PRINT
304 PRINT"ADDING LOG ENTRIES BY DATA STATEMENTS":LIST 1000
400 REM PRINT LOG ENTRIES BY DATE
402 PRINT:PRINT
404 INPUT"ENTER FIRST DATE (YYMMDD)";N1:PRINT
406 INPUT"ENTER NEXT DATE (YYMMDD)";N2:PRINT
408 PRINT"LOG ENTRIES BETWEEN "N1" AND "N2:PRINT:GOSUB  800
412 GOSUB 700
414 IF Z=999999 THEN 950
416 IF Z>=N1 AND Z<=N2 THEN 428
418 GOTO 412
420 GOSUB 720
422 GOTO 412
500 REM PRINT LOG ENTRIES BY CALL SIGN
502 PRINT:PRINT
504 INPUT"ENTER CALL SIGN";M$:GOSUB 800
506 GOSUB 700
508 IF A=999999 THEN 950
510 IF M$=X$ THEN 514
512 GOTO 506
514 GOSUB 720
516 GOTO 506
600 REM PRINT ALL LOG ENTRIES
602 PRINT:PRINT
604 GOSUB 800
606 GOSUB 700
610 GOSUB 720
612 GOTO 606
700 REM READ DATA FILE
702 READ A:Z=A:IF Z=999999 THEN GOTO 950
704 READ A$:Y$=A$
706 READ B$:X$=B$
708 READ C$:W$=C$
710 READ D$:V$=D$
712 READ E$:U$=E$
714 READ F$:T$=F$
716 READ G$:S$=G$
718 RETURN
720 REM PRINT DATA RECORD
722 PRINT Z$"  "Y$;"  "X$;"  "W$;"  "V$;"  "U$;"  "T$;"  "S$
724 RETURN
800 REM REPORT HEADER
801 PRINT "REPORT DATE "D:PRINT
802 PRINT" DATE     TIME  CALL    FREQ MODE  PWR QSL QTH   NAME"
804 FOR N=1 TO 51:PRINT"=";:NEXT N:PRINT"="
806 RETURN
950 REM END OF REPORT
952 PRINT"END OF REPORT":RESTORE:GOTO 105
999 END
1000 DATA 770502,1805,K9QAG,14.2,SSB,260,N,IL  HERMIE
1001 DATA 770502,1832,VB6RRF,14.2,SSB,260,N,CA GLENN
1002 DATA 770503,1158,ZL1BAG,14.2,SSB,260,N,NZ HAL
1003 DATA 770504,0914,VA8ZDR,14.3,SSB,260,N,KA SKIP
1004 DATA 770505,1105,VB5VCG,14.3,SSB,260,Y,NM DAVE
1005 DATA 999999
>
PRINT FRE(X)
 3787

>
```

Fig. 2. Program listing.

```
RUN

AMATEUR RADIO LOG AND INQUIRY SYSTEM

ENTER TODAY'S DATE (YYMMDD)? 770530

SELECT ONE OF THE FOLLOWING FUNCTIONS

   1. ADD LOG ENTRIES
   2. PRINT LOG ENTRIES BY DATE
   3. PRINT LOG ENTRIES BY CALL SIGN
   4. PRINT ALL LOG ENTRIES

ENTER FUNCTION NUMBER? 4

REPORT DATE  770530

 DATE     TIME  CALL    FREQ MODE  PWR QSL QTH   NAME
==========================================================
 770502   1805  K9QAG   14.2  SSB  260  N  IL  HERMIE
 770502   1832  VB6RRF  14.2  SSB  260  N  CA  GLENN
 770503   1158  ZL1BAG  14.2  SSB  260  N  NZ  HAL
 770504   0914  VA8ZDR  14.3  SSB  260  N  KA  SKIP
 770505   1105  VB5VCG  14.3  SSB  260  Y  NM  DAVE
END OF REPORT

SELECT ONE OF THE FOLLOWING FUNCTIONS

   1. ADD LOG ENTRIES
   2. PRINT LOG ENTRIES BY DATE
   3. PRINT LOG ENTRIES BY CALL SIGN
   4. PRINT ALL LOG ENTRIES

ENTER FUNCTION NUMBER? 3

ENTER CALL SIGN? ZL1BAG
REPORT DATE  770530

 DATE     TIME  CALL    FREQ MODE  PWR QSL QTH   NAME
==========================================================
 770503   1158  ZL1BAG  14.2  SSB  260  N  NZ  HAL
END OF REPORT

SELECT ONE OF THE FOLLOWING FUNCTIONS

   1. ADD LOG ENTRIES
   2. PRINT LOG ENTRIES BY DATE
   3. PRINT LOG ENTRIES BY CALL SIGN
   4. PRINT ALL LOG ENTRIES

ENTER FUNCTION NUMBER? 2

ENTER FIRST DATE (YYMMDD)? 770503

ENTER NEXT DATE (YYMMDD)? 770504

LOG ENTRIES BETWEEN  770503  AND  770504

REPORT DATE  770530

 DATE     TIME  CALL    FREQ MODE  PWR QSL QTH   NAME
==========================================================
 770503   1158  ZL1BAG  14.2  SSB  260  N  NZ  HAL
 770504   0914  VA8ZDR  14.3  SSB  260  N  KA  SKIP
END OF REPORT

SELECT ONE OF THE FOLLOWING FUNCTIONS

   1. ADD LOG ENTRIES
   2. PRINT LOG ENTRIES BY DATE
   3. PRINT LOG ENTRIES BY CALL SIGN
   4. PRINT ALL LOG ENTRIES

ENTER FUNCTION NUMBER? 1

ADDING LOG ENTRIES BY DATA STATEMENTS

1000 DATA 770502,1805,K9QAG,14.2,SSB,260,N,IL  HERMIE
1001 DATA 770502,1832,VB6RRF,14.2,SSB,260,N,CA GLENN
1002 DATA 770503,1158,ZL1BAG,14.2,SSB,260,N,NZ HAL
1003 DATA 770504,0914,VA8ZDR,14.3,SSB,260,N,KA SKIP
1004 DATA 770505,1105,VB5VCG,14.3,SSB,260,Y,NM DAVE
1005 DATA 999999
>
```

Fig. 3. Sample run.

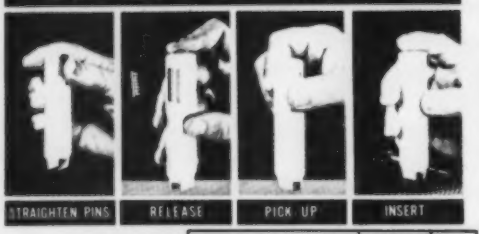
read, store, control, and print, the program becomes quite small. For example, lines 700 to 718 read the data, test for end of data, and store the data in string variables Z, Y$, X$, W$, V$, U$, T$, and S$. After reading, control returns to the calling portion of the program, usually to test either variable Z for dates or X$ for callsign. If variable Z is within the date range, variables N1 and N2 or X$ equal variable M$. Then the printing subroutine (lines 720 to 724) is executed. In any case, the next data line is read and tested again at line 702. If Z = 999999, then "END OF REPORT" is printed, the data pointer is RESTORED, and a new function is requested.

Storage in lines 702 to 716 was done to accommodate any changes which might destroy the A to G$ variables by intermediate printing, logic, or data manipulation. These same lines could easily have been written with FOR ... NEXT commands, as could the printing subroutines, but I decided to keep the program simple for small BASIC interpreters. By changing lines 100, 115, 120, 125, 304, 408, 504, 802, and the data lines, just about any kind of data record search can be accommodated.

Other functions could easily be added, also. For example, you may want a printout of all the contacts that have or have not sent a QSL. This could be done by a comparison just like the one in line 510. Only change X$ to V$, then add the required function call number and assign the line numbers. By using AND/OR logic operators, such as in line 416, a varying and quite flexible search can be established. You could print out log entries, such as by date and/or call, or whatever the data statements and logic are set up to look for. ■

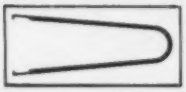
ok

DIP/IC INSERTION TOOL with PIN STRAIGHTENER



14-16 Pin Dip IC Inserter	INS-1416	$3.49

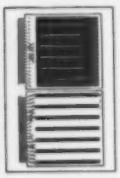
DIP/IC EXTRACTOR TOOL



The EX-1 Extractor is ideally suited for hobbyist or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.

Extractor Tool	EX-1	$1.49

P.C. BOARD



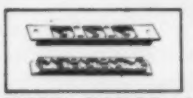
The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector, with contacts on standard .156 spacing. Edge contacts are non-dedicated for maximum flexibility.

The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Typical density is 18 of 14-Pin or 16-Pin DIP's. Components may be soldered directly to the board or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual busses running the full length of the board for complete wiring flexibility. These busses enable access from edge contacts to distant components. These busses can also serve to augment the voltage or ground busses, and may be cut to length for particular applications.

Hobby Board	H-PCB-1	$4.99

PC CARD GUIDES

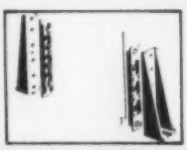


QUANTITY – ONE PAIR (2 pcs.)

TR-1 consists of 2 guides precision molded with unique spring finger action that dampens shock and vibration, yet permits smooth insertion or extraction. Guides accommodate any card thickness from .040-.100 inches.

Card Guides	TR-1	$1.89

PC CARD GUIDES & BRACKETS



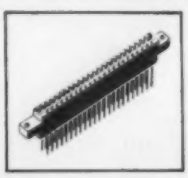
QUANTITY – ONE SET (4 pcs.)

TRS-2 kit includes 2 TR-1 guides plus 2 mounting brackets. Support brackets feature unique stabilizing post that permits secure mounting with only 1 screw.

Guides & Brackets	TRS-2	$3.79

QUANTITY – ONE SET (4 pcs.)

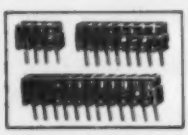
PC EDGE CONNECTOR



44 Pin, dual read out, .156" (3,96 mm) Contact Spacing, .025" (0,63 mm) square wire-wrapping pins.

P.C. Edge Connector	CON-1	$3.49

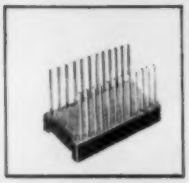
P.C.B. TERMINAL STRIPS



The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1, 8-0, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

4-Pole	TS- 4	$1.39
8-Pole	TS- 8	$1.89
12-Pole	TS-12	$2.59

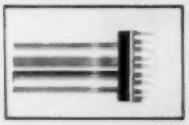
DIP SOCKET



Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins .025 (0,63mm) sq., .100 (2,54mm) center spacing.

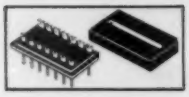
14 Pin Dip Socket	14 Dip	$0.79
16 Pin Dip Socket	16 Dip	$0.89

RIBBON CABLE ASSEMBLY SINGLE ENDED



With 14 Pin Dip Plug 24" Long (609mm)	SE14-24	$3.55
With 16 Pin Dip Plug 24" Long (609mm)	SE16-24	$3.75

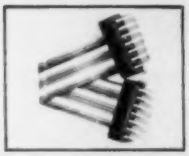
DIP PLUG WITH COVER FOR USE WITH RIBBON CABLE



14 Pin Plug & Cover	14-PLG	$1.45
16 Pin Plug & Cover	16-PLG	$1.59

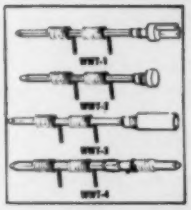
QUANTITY: 2 PLUGS, 2 COVERS

RIBBON CABLE ASSEMBLY DOUBLE ENDED



With 14 Pin Dip Plug -2" Long	DE 14-2	$3.75
With 14 Pin Dip Plug -4" Long	DE 14-4	$3.85
With 14 Pin Dip Plug -8" Long	DE 14-8	$3.95
With 16 Pin Dip Plug -2" Long	DE 16-2	$4.15
With 16 Pin Dip Plug -4" Long	DE 16-4	$4.25
With 16 Pin Dip Plug -8" Long	DE 16-8	$4.35

TERMINALS



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- Gold Plated

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26 ga. Wire Cut and Strip Tool	ST-100-26-875	⅞" — 1⅛"	$ 8.75
28 ga. Wire Cut and Strip Tool	ST-100-28	⅞" — 1⅛"	$11.50
30 ga. Wire Cut and Strip Tool	ST-100-30	⅞" — 1⅛"	$11.50

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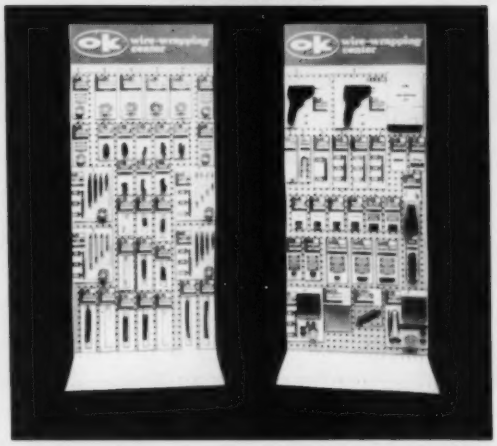

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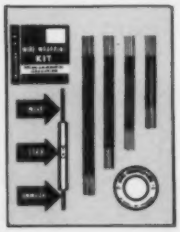

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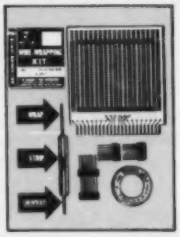
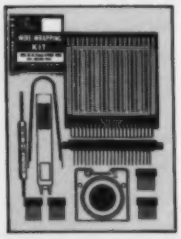
Wire Wrapping Kit. (White)	WK-2-W	$12.95
Wire Wrapping Kit (Red)	WK-2-R	$12.95



WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30, Roll of wire R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

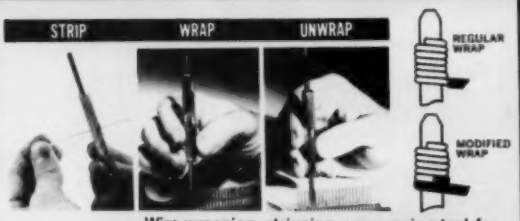
Wire-Wrapping Kit	WK-3B (Blue)	$16.95



WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

Wire-Wrapping Kit	WK-4B (Blue)	$25.99



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Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30	$6.95
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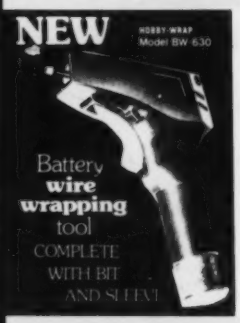

WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	$34.95*
For AWG 26-28	BW-2628	$39.95*

Bit for AWG 30	BT-30	$3.95
Bit for AWG 26-28	BT-2628	$7.95

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30 AWG Yellow Wire 50ft. Roll	R-30Y-0050	$1.98
30 AWG White Wire. 50ft. Roll	R-30W-0050	$1.98
30 AWG Red Wire. 50ft. Roll	R-30R-0050	$1.98

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- Strips 1" of insulation.
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White Wire	WD-30-W	$3.95
Red Wire	WD-30-R	$3.95

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30 AWG Yellow Wire. 1" Long	30-Y-50-010	$.99
30 AWG White Wire. 1" Long	30-W-50-010	$.99
30 AWG Red Wire. 1" Long	30-R-50-010	$.99
30 AWG Blue Wire. 2" Long	30-B-50-020	$1.07
30 AWG Yellow Wire. 2" Long	30-Y-50-020	$1.07
30 AWG White Wire. 2" Long	30-W-50-020	$1.07
30 AWG Red Wire. 2" Long	30-R-50-020	$1.07
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30 AWG White Wire. 3" Long	30-W-50-030	$1.16
30 AWG Red Wire. 3" Long	30-R-50-030	$1.16
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30 AWG White Wire. 4" Long	30-W-50-040	$1.23
30 AWG Red Wire. 4" Long	30-R-50-040	$1.23
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30 AWG Yellow Wire. 5" Long	30-Y-50-050	$1.30
30 AWG White Wire. 5" Long	30-W-50-050	$1.30
30 AWG Red Wire. 5" Long	30-R-50-050	$1.30
30 AWG Blue Wire. 6" Long	30-B-50-060	$1.38
30 AWG Yellow Wire. 6" Long	30-Y-50-060	$1.38
30 AWG White Wire. 6" Long	30-W-50-060	$1.38
30 AWG Red Wire. 6" Long	30-R-50-060	$1.38

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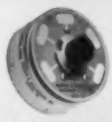
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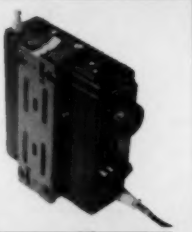

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RAM Checkout's A Snap

—this tiny program does the job

Rod Hallen WA7NEV
P.O. Box 73
Tombstone AZ 85638

This "memory monitor" is a simple assembly language program designed to load zeros or sequential numbers into a block of memory for testing purposes. My original version would only load 256 bytes at a time, which made testing a new 8K board somewhat of a chore, since it had to be run 32 times (256 x 32 = 8K). This final version will load from 1 to 65,536 (64K) bytes of memory. That should be enough to satisfy everyone.

Address	Op codes	Mnemonics
C900	0E 01	MVI C 01
C902	11 FF 1F	LXI D FF 1F
C905	21 00 00	LXI H 00 00
C908	36 00	MVI M 00
C90A	7E	MOV A M
C90B	81	ADD C
C90C	23	INX M
C90D	77	MOV M A
C90E	1B	DCX D
C90F	3E 00	MVI A 00
C911	BA	CMP D
C912	C2 0A C9	JNZ 0A C9
C915	BB	CMP E
C916	C2 0A C9	JNZ 0A C9
C919	C3 04 C0	CALL TO RESIDENT COMMAND MODE

Fig. 1. A complete listing of the memory monitor.

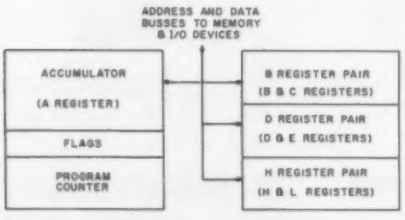

Fig. 2. A simplified drawing of the 8080. The registers which make up the B-, D-, and H-register pairs can be used either in pairs or as individual registers, depending on your requirements. The 8080 contains many other features which are not shown here.

SOL Operations

First, let me describe how my SOL system works so that you can decide how the following explanation pertains to your machine. The SOL has a program in PROM called CONSOL, which handles the keyboard, video, and other routines. I can enter data to memory by typing "ENTER – (address) – (data) – CR," and I can dump memory to the video screen by typing "DUMP – (start address) – (finish address) – CR." If the difference between the start address and the finish address is less than 256 bytes, all of the data requested will fill the screen. If more than 256 bytes are requested, the readout will start at the top of the screen and, when it reaches the bottom, will scroll upward until all of the requested data has appeared.

Apparently, the same ENTER and DUMP (examine) operations will work on a computer which uses front panel switches, but they will be done at a much slower rate. Testing a memory board can be accomplished on any machine by first manually loading data into each memory location on the board and then dumping or examining each location to determine that the correct information was indeed written. My memory monitor does it much more quickly! See Fig. 1. I am very much a novice when it comes to programming, so I make no claim that this is the easiest, fastest, or best way to get the job done.

Breakdown

If you are not familiar with assembly language, you might be interested in how the memory monitor does what it does. In fact, let's look at it line by line. Since SOL and I talk to each other in a number form called hexadecimal, all numbers in this program are hexadecimal (hex for short).

The first column in Fig. 1 is headed "Address," and that tells me where this program will be located in memory. When I tell SOL, "EXECUTE C9ØØ," it will go to memory location C9ØØ, execute the instruction located there, and then continue down the list of instructions until told to stop.

The second column is headed "Op code." These are the instructions, addresses, and data that the computer will use to perform its task.

Column three is headed "Mnemonic" (mnemonic means something that helps the memory). Mnemonics are the assembly language abbreviations for the op codes (machine language codes).

I started the program at location C9ØØ because the SOL has 1K of onboard RAM beginning at that location. You can put it anywhere you like, but you must rewrite the two JNZ (jump non-zero) in-

structions. As they stand, a jump will be made to C9ØA (8080 address and register pair instructions are always written with the address or data backwards). If you wanted to load the memory monitor at location 8ØØØ, for instance, you would change C9 to 8Ø at each place that it appears in the program. This is called relocating the program.

In the first line, Ø1 in location C9Ø1 tells the computer how you want it to load the memory locations. ØØ here would load all zeros (erase memory), and Ø1 would load sequential numbers, ØØ, Ø1, Ø2, etc. Ø2 would load ØØ, Ø2, Ø4, etc.

The FF 1F at locations C9Ø3 and C9Ø4 tells the computer how many address locations you want to load. FF 1F is actually 1FFF (backwards), which is 8K in the hexadecimal number system. See Fig. 3. If you wanted to load a 4K board, then line C9Ø2 would read 11 FF ØF.

Line C9Ø5 lets the computer know which address to start the loading at. The addressing of most memory boards is determined by setting on-board switches or by running jumpers. For this test, I addressed my 8K board to start at address ØØØØ, but it could be set to start anyplace you want, and instruction C9Ø5 should reflect this address. If you wanted to locate this board at 6ØØØ because you already had something at ØØØØ, line C9Ø5 would read 21 ØØ 6Ø (address reversed as usual).

Enter the program into the memory locations you have selected. Execute the first address, and the computer will load ØØ into the starting address on the board to be tested, Ø1 in the next location, Ø2 in the next, and so on, until it has loaded as many locations as you requested. Then it will stop.

Fig. 2 is a simplified drawing of the internal makeup of the 8080 microprocessor. Making use of Figs. 1 and 2, let's step through the memory monitor as the computer would and see what happens. First, my "EXECUTE C9ØØ" command will load C9ØØ into the program counter in the 8080 and start processing instructions from there. The program counter keeps track of which instruction comes next in the program.

The microprocessor can always tell from the first byte of an instruction whether it is a one-, two-, or three-byte instruction. As a start, it will fetch ØE, which is what it found at location C9ØØ, and, since it knows that ØE is a two-byte instruction, it will also fetch Ø1, which is in C9Ø1. ØE (MVI C) tells the processor to take the byte that follows ØE and load it into the C-register. The PC (program counter) then steps to C9Ø2 and starts a new fetch which is 11 plus FF 1F (LXI D FF 1F). 11 says load the following two bytes into the D-register pair (registers D and E). C9Ø5 – 21 ØØ ØØ (LXI H ØØ ØØ) loads ØØ ØØ into the H-register pair (registers H and L), and C9Ø8 – 36 ØØ (MVI M ØØ) tells the processor to load ØØ into the location whose address is found in the H-register pair. In other words, you put the address where you want to start your memory board test into the H-register pair (ØØØØ) and then tell the processor to load ØØ at that location.

Next, move the contents (ØØ) of the start test location (ØØØØ) into the A-register (accumulator) C9ØA – 7E (MOV A M), which means that you are about to work on it. The next instruction C9ØB – 81 (ADD C) will add the contents of register C to the accumulator (ØØ + Ø1), and C9ØC – 23 (INX M) increases the address in the H-register pair by one. C9ØD – 77 (MOV M A) takes the contents of the accumulator (Ø1) and puts them into the location whose address is now in the H-register pair (location ØØØ1). Now you have ØØ in location ØØØØ and Ø1 in location ØØØ1. C9ØE – 1B (DCX D) subtracts one from the contents of the D-register pair, and C9ØF – 3E ØØ (MVI A ØØ) puts ØØ into the accumulator.

At the start, the D-register pair contained the total number of locations you wanted to load. After you've gone through the program once and subtracted one from D, check to see if you are finished. The accumulator contains the ØØ which you loaded there. C911 – BA (CMP D) compares the contents of the D-register with the contents of the accumulator (ØØ) and, if they are equal, sets the zero flag. If they are not equal, C912 – C2 ØA C9 (JNZ ØA C9) will take you back to C9ØA for another run through the program.

If they are equal (both ØØ), the program counter will move to C915 – BB (CMP E) and compare the E-register, which is the lower half of the D-register pair, to see if it is zero also. C916 – C2 ØA C9 (JNZ ØA) works the same as C912 and reruns the program or passes to the next instruction, depending on the condition of the zero flag. When both registers of the D-register pair are equal to zero, then you have loaded as many memory locations as you originally asked for.

It is now time to exit the program. C919 – C3 Ø4 CØ is a call to the command mode in the SOL CONSOL operating system. When SOL is

Decimal		Hexadecimal
256		FF
512		1FF
768		2FF
1024	(1K)	3FF
2048	(2K)	7FF
3072	(3K)	BFF
4096	(4K)	FFF
8192	(8K)	1FFF
16384	(16K)	3FFF
32768	(32K)	7FFF
65536	(64K)	FFFF

Fig. 3. A decimal-to-hexadecimal conversion table.

0000	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0010	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
0020	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
0030	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
0040	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
0050	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
0060	60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
0070	70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
0080	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
0090	90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
00A0	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
00B0	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
00C0	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
00D0	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
00E0	E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
00F0	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Fig. 4. A memory dump of the first 255 bytes of memory in the SOL. As can be seen, the computer has counted from Ø to 256 in hexadecimal.

turned on or the reset switch is pushed, the computer enters the command mode, puts a prompter (>) on the screen, and waits for me to tell it what to do. This line can be a jump or call to any location you desire and will depend on your machine's operating characteristics.

In order to determine how the test went, I type "DUMP ØØØØ 1FFF," which covers all of the memory locations of this 8K board, and the screen will scroll through these locations. It's much too fast to really check individual locations, but I'm really only interested in the last location. Since the contents of each location are the contents of the previous location plus one, the contents of 1FFF should be FF, if the test went well. If they aren't, then it is necessary to dump 256 byte pages one at a time until the problem area is found. With this program, I found three 2102 pins that were bent under the IC instead of inserted into the sockets. Fig. 4 is what the first 256 bytes of memory look like after running the program.

Summary

Instruction information for the 8080 is contained in the *Intel 8080 Microcomputer Systems User's Manual* and the *Intel 8080 Assembly Language Programming Manual.* The "Intel 8080 Assembly Language Reference Card" is also useful. Anyone who is serious about assembly language programming the 8080 should have all of these.

Any program, whether it is very simple or incredibly complex, is nothing more than a logical progression through a series of instructions. Pick some little chore that you'd like your machine to do, break it down into logical steps, convert those steps into assembly language instructions, and you'll be surprised and happy with the results. ■

Corrections

We would like our readers to note that ECONORAM, as it appeared in our July, 1978, issue ("RAMmed by Morrow—ECONORAM III lauded"), page 110, should have been written ECONORAM™.

John C. Burnett
Managing Editor

I have received quite a bit of mail about my article which you published in the Aug., 1977, issue of *73* entitled, "Build a Double Bazooka." A great deal of interest was evinced, and there were quite a few comments about the fact that the article had been written in a simple enough style that the average ham could understand it. I've naturally fully answered all letters. However, there was one small item, having to do with the printing, that has caused a bit of trouble.

As I have received several requests about its clarification, would you be able to put in a corrected sketch of Fig. 7? I believe that will help some amateurs who did not clearly see what the sketch was intended to show. The clarified sketch is shown below.

The correction may be particularly useful to fellows who are in other countries, and to those who perhaps did not easily understand the parallel coaxial bazooka that I developed.

Bill Vissers K4KI
Cocoa Beach FL

I would like to take this opportunity to apologize to you and your readers for not notifying you sooner through the "Letters" section of the demise of CONTACT, which I mentioned in most of my articles.

Inflation has hit the PC business just like everyplace else, and, since I refuse to sell junk or home-etched boards, we were forced out of the business by the last couple of boards. I still have on hand a couple hundred dollars of inventory of the COR and Auto-Dialer boards which never sold, and I was looking at expenses in the neighborhood of $2000 to prepare boards for the next series of articles, so CONTACT went under, at least for the time.

Again, I regret not publishing this earlier and the inconvenience it has caused some readers of my articles.

Bill Hosking W7JSW
Scottsdale AZ

We erred. In "Yes, You Can Build A Synthesizer!" (July, 1978), several schematics were out of place. The correct Fig. 3 (p. 126) was printed on page 131 as Fig. 16. The correct Fig. 16, which was omitted, is shown below. The correct Fig. 17 was printed on page 126 as Fig. 3.

Finally, page 130, column 4, line 8 should read: "equal to the receiver's first i-f ÷ 10 kHz."

John C. Burnett
Managing Editor

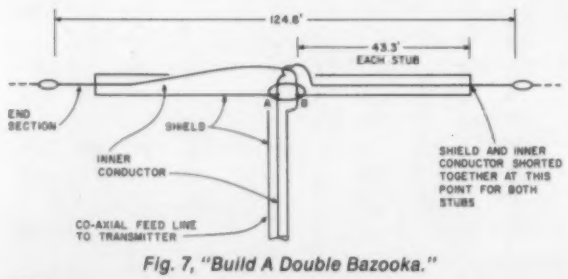

Fig. 7, "Build A Double Bazooka."

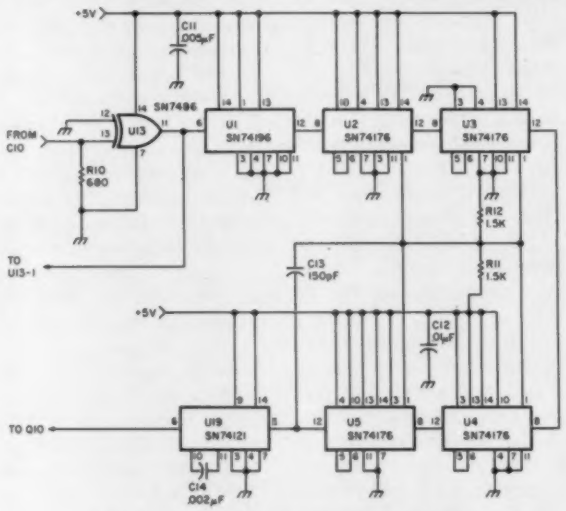

Fig. 16, "Yes, You Can Build A Synthesizer!"

Ham Help

I have recently obtained a General Electric closed circuit television camera which I plan to use on amateur slow scan. My problem is that the unit came minus control cables. The cable terminates in two Amphenol series 67 connectors with 42 pins. Some assistance would surely be appreciated. Thank you.

Jim Davis WD5IMS/8
24712 E. Woodside
Farmington Hills MI 48018

I'm looking for the maintenance manuals and schematics for the National HRO-500 receiver. These receivers have been used in MARS programs over the years. I am willing to pay for duplication costs, if not too exorbitant.

Anton M. Giroux DA1NF/
WD6AXL
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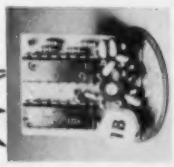

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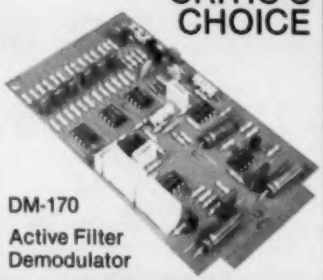

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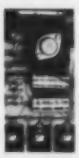

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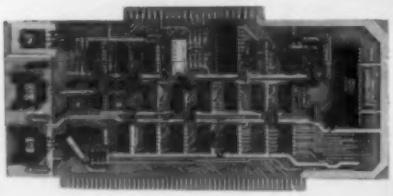

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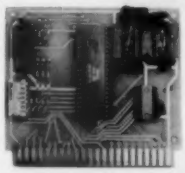

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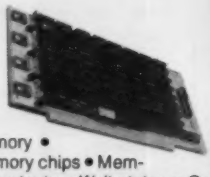

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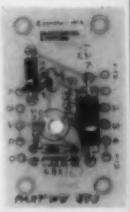

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Photos by John Dugan

The Case of the Missing Offset

—adding to the HW-2021

After using the Heathkit® HW-2021 2 meter FM hand-held for a little over a year, it has come time to answer the most often asked question of the missing +600 kHz offset once and for all.

Heath has made available to us an inexpensive kit complete with nicad batteries, charger, and rubber ducky antenna. Mine was assembled carefully and has worked fine from the beginning. The transmitter power is adequate, and the receiver is both sensitive and selective. Since all the needed accessories are included with the kit, it is one of the best buys in the hand-held market.

Photo A. Heathkit HW-2021 with the touchtone pad and ¼-wave antenna installed.

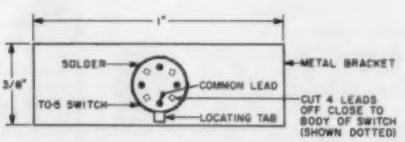


Fig. 1. Offset switch, bottom view (lead end).

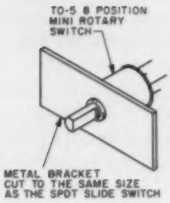


Fig. 2. Offset switch assembly.

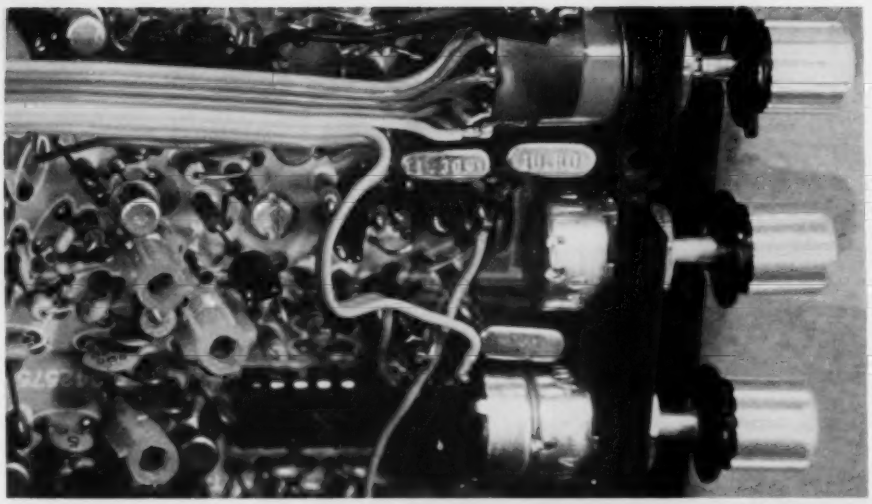


Photo B. Interior wiring details showing new switch and new crystal location.

There is a unique battery-saver pulsing circuit built into the receiver to extend the hours of operating time before the batteries require charging. Rather than the receiver remaining on all of the time, it is pulsed on five times per second, staying on only an instant, unless a signal is present. The battery drain at this time is barely measurable. When a signal breaks the squelch, the receiver stays on and operates normally.

Only one crystal per channel is required, bringing about a further savings when filling up the five available channels. The crystal used is cut for the receive frequency. The crystal netting capacitor can be tweaked just about exactly on frequency with a discriminating ear by listening to the incoming audio. This is great for the times you don't have access to a frequency counter but want to plunk in another channel. The transmit frequency is determined by offsetting the receive frequency, and that's where the rub comes in.

Heath, through some oversight, has overlooked the popularity of 147 MHz repeaters in the crowded suburban areas. As received from Heath, the HW-2021 comes with a two-position transmitter offset switch and two crystals to allow for simplex operation or a -600 kHz offset for the 146 MHz repeaters. The closest Heath comes to accommodating a +600 kHz offset for the 147 MHz repeaters is to list the specifications for a 11.3 MHz crystal to do the job. To use it without making any further changes, you have to sacrifice either simplex operation or the -600 kHz offset. I wanted to work through the repeaters in both ends of the band without giving up simplex operation. The modification outlined here was planned before I even purchased the rig.

The size of a hand-held unit makes any modifications more difficult than they would be in a larger piece of gear. In this instance, finding an SP3T slide switch that would fit in place of the original SPDT switch turned out to be a hopeless task. It seems that nobody makes a subminiature SP3T. I didn't want to alter the HW-2021 case too drastically. The 11.3 MHz crystal had been ordered through an ad in *73* but sat gathering dust for want of a suitable switch.

Then one day it came to me—if an SP3T switch won't fit, why not try a SP8T switch? There are times when the electronic surplus market brings new and exotic components down to a reasonable price. This time, just that happened. The TO-5 mini rotary switch had just appeared in a James ad in *73 Magazine* for less than a dollar. I quickly ordered a handful and got back in gear again. Actually the switch is an SP7T with the eighth position being an off function. It was, however, small enough to use.

After identifying the common lead on the switch and making certain it was saved, alternate leads were cut off close to the body of the switch (see Fig. 1). I removed the extra leads to allow more space to wire to the remaining four. You now have an SP3T rotary switch with valid positions spaced at ninety degrees. There are five dead positions. Remove the original offset slide switch, unsoldering the three bare leads at the switch. Leave the three leads connected in the PC board, at the same length, for now. Cut a metal bracket from a piece of thin metal to the size of the original slide switch, so it will fit in the molded slot in the case. Drill the bracket in the center a little larger than the diameter of the plastic shaft of the TO-5 switch. Orient the TO-5 switch with the locating tab, as shown in Fig. 1, and solder the switch case to the metal bracket.

Insert the rotary switch in the slot in the bottom half of the case. Fit the top half of the case loosely. You will see where the tab on the top half interferes slightly with the switch shaft. File the tab on the top half with a round file, as necessary, to allow the switch to turn freely. It doesn't take much.

Reconnect the three bare wires still connected at the PC board to the new switch, as shown in Fig. 3. Trim the lengths so the wires just reach past the respective leads on the switch. You don't want the typical good mechanical connection prior to soldering here, since future removal of the PC board from the case is more easily accomplished by removing the offset switch first.

Remove the two existing crystals for the simplex and -600 kHz offset. You will move them around to make the switch positions more logical when you are finished. Insert the -600 kHz offset crystal (10.100 MHz) in the PC board socket where shown in Fig. 4. Similarly, insert the new

Photo C. Offset switch legend.

+600 kHz offset crystal (11.300 MHz) where shown in Fig. 4.

No location exists in the PC board for the third crystal, which is now the simplex crystal (10.700 MHz). There is a very convenient spot beside the channel selector switch which this crystal will fit into with a minimum of effort. First bend the pins on the crystal very slightly to the side (see Fig. 5). My kit from Heath conveniently included two additional crystal pin sockets (part #432-878). Maybe they all do or maybe it was just luck, but I used them for the third crystal rather than soldering directly to the pins. Slip on the extra pin sockets if you have them, and solder a short length of insulated wire to each socket or crystal pin. I used shrink tubing over this connection for further insulation.

Loosen the channel selector switch mounting nut, and move the switch as close to the squelch control as the mounting hole in the case will allow. There is a little slop in the mounting hole. Put a piece of plastic electrical tape over the channel switch terminals. Insert the 10.700 MHz crystal down in the slot between the channel switch and the case with the pins up (see Fig. 4). The crystal will remain captive without anything else securing it in this location.

Carefully mate the case halves together. Do not force them. The crystal pins may rub on the top half if they are not bent enough. As a precaution, I scraped a little of the silver paint from the inside of the top case half where they might touch. This is metallic paint and is at ground potential. If the channel selector switch binds after adding this crystal, rather than turning freely as before, it must be moved even closer to the squelch control. The case may go together a little more snugly now, but it shouldn't require enough force to damage anything.

After the crystal is mechanically installed, solder the wire coming from the near pin on the crystal to the remaining pin on the offset selector switch (see Fig. 3). The remaining lead from the crystal goes to ground. I connected it to the top lead of resistor R88 which is convenient and at ground potential.

I used an electric engraving pencil to mark the switch legend on the side of the case. After engraving, fill the grooves with white paint to make them more visible (see Fig. 6). I marked mine simply, "146—Simplex—147," rather than the usual +600 and -600; it's less to remember. If you oriented the switch the same as I did, the flat side of the TO-5 shaft acts as the pointer. I painted the flat side red for quick identification in the light. At night or when operating mobile, the flat is easily identified by feel. Switching positions on the switch is done by thumbnail, using the slot cut into the end of the shaft.

As with any other 2m rig using a plus or minus 600 kHz offset switch, a certain amount of memory must be programmed into the operator at this time. You will find, as I have, that transmitting with the -600 kHz offset dialed in and a 147.09 receive crystal selected will never break the squelch on a 69-09 machine. It probably puzzles anyone using 146.49 simplex at the time, though! Another error to watch out for is using 146.52 with the -600 kHz offset. I imagine this is a probable source of the occasional FM signal that

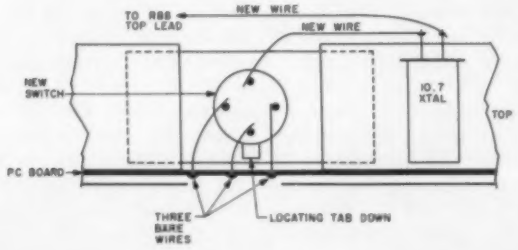


Fig. 3. Offset switch wiring diagram.

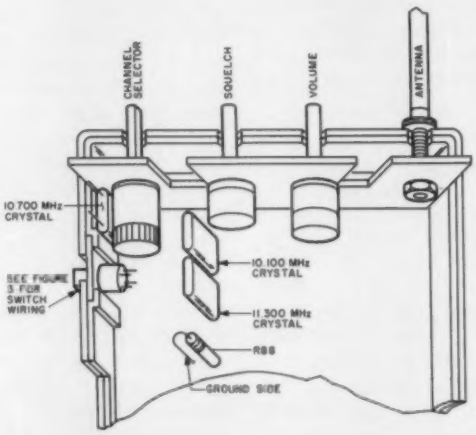


Fig. 4. Parts placement diagram.

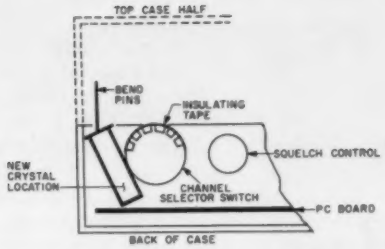


Fig. 5. New crystal location.

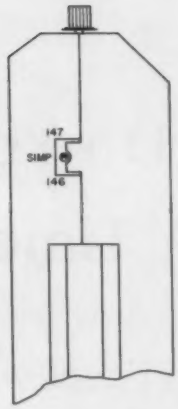


Fig. 6. Switch legend.

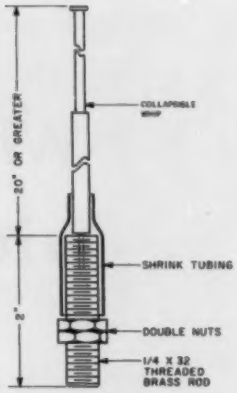


Fig. 7. ¼-wave whip details.

tears up the OSCAR satellites. 145.92 MHz is in the input range of both OSCAR 6 and OSCAR 7.

Now that you have the HW-2021 operating on the whole 2 meter FM band, here are a few other features you can add to improve its performance and versatility. As with any other hand-held, a ¼-wave antenna extends the usable range of this rig far beyond that possible with the rubber ducky provided. Heath has made it a little tougher than usual due to their fixation with nonstandard rf connectors. The HW-2021 antenna has a ¼ x 32 threaded connection, rather than the usual BNC connector. This causes no problem for mobile use. Although unusual, the shorting phone jack provided allows easy connection to an external roof-mounted mobile antenna. There is a problem when you want a ¼-wave or 5/8-wave whip on top of the hand-held. The ¼ x 32 is not a common thread. The standard readily-available ¼-inch diameter bolts are ¼ x 20 or ¼ x 28. I eventually ended up at a local machine shop where they were able to turn a length of brass rod to the ¼ x 32 thread. They also came up with some matching ¼ x 32 nuts.

I used a 21-inch collapsible whip from a broadcast radio for my ¼ wave. Use a two-inch length of the threaded rod drilled at one end to accept the collapsible whip. Solder the two together. Double nut the threaded rod about ½ inch from the other end to provide a stop when screwing it into the HW-2021. Put a piece of shrink tubing over the connection to make it look neat. Fig. 7 shows my system. Final operating length for the whip was determined by varying the length while getting signal reports from another station about ten miles away.

As the photographs show, I also added a touchtone encoder for autopatch and remote-control use. Heath makes an encoder kit for the HW-2021, but I shied away from it because of the possible temperature sensitivity of the 555 timer circuitry, as well as the frequency adjustments it requires. Instead, I chose an encoder sold by the Barber Corporation in Waynesville, Ohio. As advertised in *73*, their pad sells for $34.50 postpaid. A matching case is required for surface mounting the pad to the face of the HW-2021. Barber also has the case for an additional $2.00 postpaid.

The sixteen-button pad was used rather than the more common twelve-button pad only because the matching case is not available for a twelve-button. The Barber unit comes assembled and is self-contained, using a Motorola MC-14410 chip and a 1 MHz reference crystal. No frequency adjustment is required for this unit, nor do the extremes of Pennsylvania's temperatures seem to affect it.

I hooked the pad up using the three-wire circuit in the Barber Corp. instructions. The HW-2021 has a high impedance input. Take the power for the pad from the transmitter circuit. Use the +12 volts from pin Z which Heath provided on the PC board for a TTP. The ground connection goes to pin Y, also provided on the PC board. The audio out from the Barber pad goes to the TTP input pin on the HW-2021 (pin H). My kit included three extra matching female connectors (part #432-120), making these connections a snap. No additional coupling capacitors are required in the audio line, but I did need a 47,000-Ohm resistor in series to keep the level compatible with my local repeaters. Some experimentation is usually required here, since no two repeaters have the same input requirements.

Start with an adjustable pot in series with the audio line to set the level to suit your repeater. Measure the final value and replace the pot with the nearest fixed value resistor. Put this resistor in the line inside the HW-2021 case where it is accessible in the event that a change in value is ever required.

The holes provided in the top of the HW-2021 case for the Heath TTP are not usable for this pad. I used plastic model cement and glued the plastic TTP case to the face of the HT case. The touchtone pad itself was also glued into its case with a light dab at each corner. Maintenance should rarely be required, but, if it is, a knife blade breaks the bond on the glue joints easily.

For mobile work in the hills of Pittsburgh, I built the TR22/15 amplifier from the article in the April, 1976, issue of *73*. The HW-2021 drives this amplifier to between ten and fifteen Watts.

I glued some spring steel clips found in a stationery store to the back of the HW-2021 for a belt clip. Later, the information on how to acquire a Motorola belt clip appeared in *73 Magazine*. It looks a little better. See the letter titled "Bug IV" on page 14 of the November, 1976, issue for ordering information for this clip.

If you have kept up with me on these modifications and improvements to your HW-2021, you are now ready to hold your head high when asked *the question* and reply: "What do you mean it's a nice looking rig but it won't operate on the 147 MHz repeater? Mine does!"■

What Do You Do With A Timekube?

—*when in doubt, modify it!*

73 Magazine *Staff*

Radio Shack has introduced its Timekube WWV receiver. Actually, one must say that it has been reintroduced. Many hams will remember using the former model of this WWV receiver in their shacks. However, the former receiver proved too expensive for Radio Shack to continue to have manufactured to sell at a price level which they felt would generate a good sales volume for such a type of receiver. So the receiver was discontinued for a time.

It is interesting, then, to examine what Radio Shack has now been able to come up with in a low-priced ($35) crystal-controlled HF receiver. After all, to receive WWV well in most areas of the country, considering WWV's signal strength and the QRM, the receiver used has to have a fairly good sensitivity and reasonable selectivity. Its performance has at least to start to approach that of a regular communications receiver.

To say it in a nutshell, the Timekube performs its intended function very well. So it is interesting to examine the receiver in a bit of detail to see what circuitry is used and to speculate on what other uses the receiver might be put to around the ham shack.

Photo A.

As its name implies, the Timekube is a compact 8 x 12 x 9 cm box that provides for the crystal-controlled reception of WWV at 5, 10, or 15 MHz. It has its own internal speaker and telescoping whip antenna and operates from a standard 9 V transistor radio battery. There is a sliding time scale on the front of the receiver, so local time in any part of the U.S. can be read off continuously opposite the GMT time scale. The only external connection provided for is to an external antenna. Operation is extremely simple in that a push-button is depressed for the desired WWV frequency.

Fig. 1 is the complete schematic of this interesting little receiver. The circuit is that of a simple single-conversion superheterodyne. A few circuit details deserve a little bit of attention. Q104 is the grounded base rf amplifier state which is tuned both at its input and output by L101 and L103, respectively. The rod antenna is connected across the high-impedance side of L101, while a link on the primary side provides for the external connection of an antenna fed by a coaxial line. Q105 is the untuned crystal oscillator stage, and S1, a push-button ganged switch, provides for crystal selection as well as for placing the proper capacitance across L101 and L103 to tune those circuits. Q101 is the mixer stage, and the rest of the receiver is basically a conventional 455 kHz i-f amplifier/AM-detector/audio amplifier configuration. The only exception is the method used to obtain improved i-f selectivity by using "crystal bypassing" in the emitter lead of Q102. This method of getting a single crystal filter into an i-f amplifier with a minimum of fuss was used years ago in some amateur circuits but rarely appeared in commercial equipment. The idea is to replace the emitter bypass capacitor with a crystal. The stage gain will be greatest at the series resonant frequency of the crystal.

Radio Shack claims a ½-microvolt sensitivity (10 dB S/N), but the actual sensitivity which could be measured was from 1 to 3 microvolts throughout the 5 to 15 MHz range. This is more than adequate for WWV reception or for a wide variety of other uses. The selectivity was what was to be expected from a single-pole crystal filter and very adequate for WWV reception. The 200-milliwatt audio output is adequate when WWV is strong, but a bit marginal when WWV is weak and one would like to hear the WWV tones with good volume. Of course, the audio output has to be a compromise with the battery life, and 200 milliwatts is the best one can do working from a 9-volt transistor radio battery.

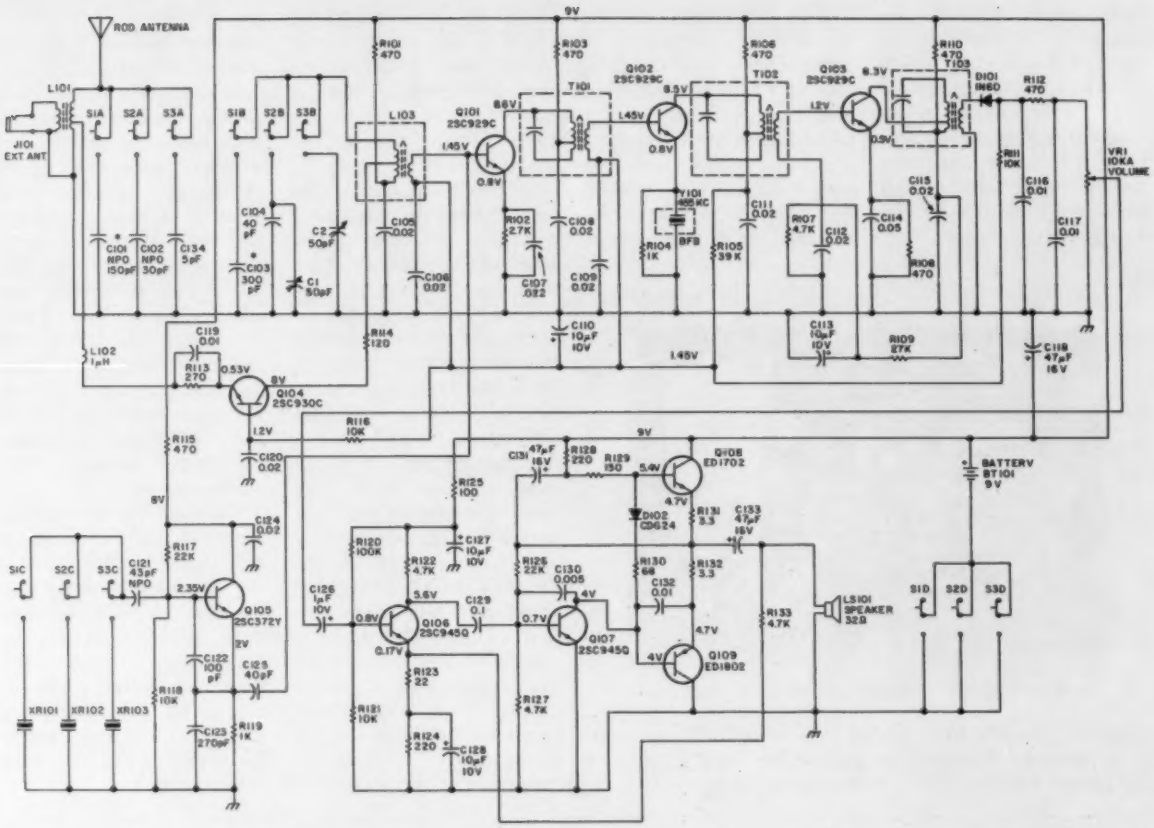


*Fig. 1. This is the complete schematic of the Timekube WWV receiver. Unless otherwise specified: resistors—in Ohms, 10% tolerance, ¼-Watt carbon; capacitors—in microfarads; voltages—dc measured with high input impedance voltmeter without signal reference to ground. *For Canadian model (12-158), C101 = 60 pF; C103 = 120 pF.*

If one purchased and used the receiver only for WWV reception, there are just two minor modifications one might consider. The antenna jack on the receiver is really an audio type commonly used for the "external speaker" or "headphone" function on a portable radio. It can be replaced by a BNC or phone plug jack for the antenna connection and is itself used as an external speaker/headphone jack.

If one considers other uses for the receiver, there is quite a range of possibilities. One of the most interesting, which requires very little modification, is to use the receiver for reception in the HF international broadcast bands. One such receiver was actually used in Europe and equipped with crystals for some VOA and BBC frequencies. So, when one wanted to hear a bit of news, etc., all one had to do was press a button and there it was. The telescoping antenna, which does not retract completely into the receiver, was removed for compactness. A short length of wire—about 5 feet—provided excellent reception.

The guts of the receiver are shown in Photo B. The whole receiver circuitry is contained on one double-sided PC board measuring slightly smaller than 11 x 7½ cm. As can be seen from the photo, changing crystals for any or all of the original three WWV crystals is not complicated. Miniature HC-25/U crystals are used and are readily obtainable from sources such as Jan Crystals at a reasonable price ($4-5). The crystal frequency is simply calculated as the desired reception frequency plus 455 kHz. The components switched in with different crystals to resonate L101 and L103 may also have to be changed depending upon how far away the new reception frequencies fall from 5, 10, or 15 MHz. For reception in the 9 and 15 MHz broadcast bands, no

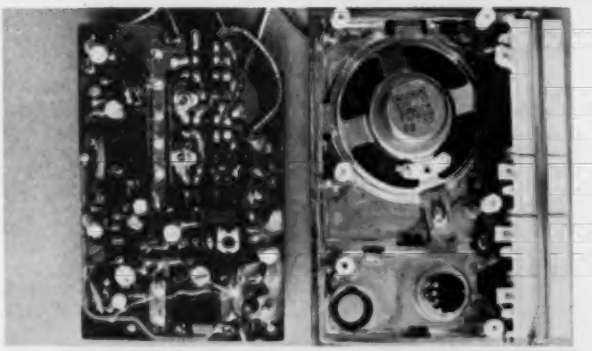


Photo B. This view shows the receiver PC board removed from the receiver enclosure. Two of the three possible crystals are installed. The bandswitch is located on the other side of the board.

components have to be changed. C1 and C2 just have to be peaked. Without changing anything except the resonating capacitors across L101 and L103, it would appear that the receiver could be used anywhere over at least the 4 to 20 MHz range.

The receiver can be modified to receive more than three crystal-controlled channels, but then the push-button switch would have to be replaced by some other form of switch—probably a rotary one. This is not as complicated as it may sound since there is adequate room in the enclosure to mount such a switch. As seen in Photo C, there is quite a bit of space left in the enclosure next to the battery cavity.

A small vfo could also be installed in the space available, so one of the selectable frequency channels could be vfo controlled. If the frequency excursion of the vfo was kept relatively small, perhaps 50 to 100 kHz, it probably would suffice to just resonate L101 and L103 in the middle of the range desired rather than have them resonate by separate variable capacitors. Any one of the many HF vfo circuits available should work, but one might try first to just substitute a parallel tuned circuit for the crystal. The oscillator supply voltage should also be zener stabilized for vfo operation.

SSB or CW reception would also be possible with the receiver if the AM diode detector D101 is replaced by a simple dual diode product detector and bfo. The only other change necessary is to reduce the agc time constant or, better yet, to obtain manual rf gain control action by connecting R11 to a 20k potentiometer placed across the 9-volt battery line. Using the basic receiver as a base, anyone with a little experience should be able to develop the unit into a very satisfactory compact QRP station receiver.

As a final thought for the versatile little Timekube, one might want to build a digital clock directly into the unit. There is certainly more than enough space to do so using any one of the many integrated clock IC display kits available along with a plug-type transformer to power the clock circuitry. ■

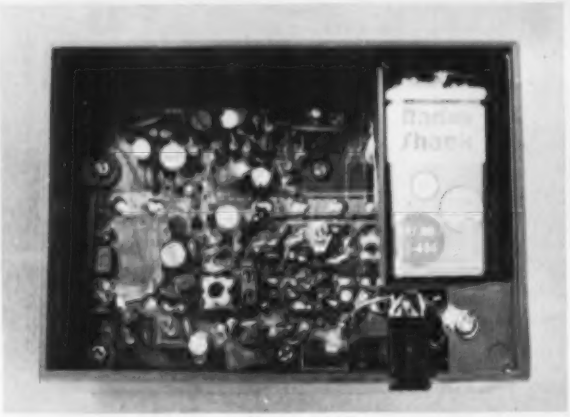


Photo C. This is a view of the receiver with the bottom cover removed. Note the space available if one wanted to add some of the accessory items discussed in the text.

LETTERS

from page 104

7, 9, and 0 being activated.

The FCC recently began issuing KA prefix callsigns to stations within the 48 contiguous states. That is our problem. KAs in Japan and KAs in the States!

Our QSL bureau is already receiving cards destined to stateside KAs, but our funds are limited and we must return the cards to the states via bulk mail, thus delaying their delivery.

The authorities responsible for issuing KA callsigns in Japan do plan to look into this problem, but it will probably be some time before any long-term solution can be found. Until that solution is found, we can only suggest that anyone sending a QSL to a KA should clearly mark the card to indicate whether it is destined for Japan (an APO or FPO address) or a stateside station.

If anyone has any questions or any suggestions, please contact me at the address below.

Ralph H. Fellows II KA2RF
Box 2785
APO San Francisco CA 96328

MICODER MOD

I have come upon some information which is sure to be of some use to your readers. The Icom IC-215 portable 2m FM rig, which seems to be a very hot seller this year, and the Heathkit Micoder seem to have a place together for a nice combination. But it seems that with the high impedance of the microphone and the low impedance of the radio mike input, the result is low tone volume and bad audio. This situation may be corrected by placing a resistor of about 560-680 Ohms between the white audio lead and ground inside the microphone. Results on several units thus far have been excellent.

William Michalson WB2VRJ
Clay NY

GET OUT OF THE ITU

I think you are 100% correct. Get out of the ITU before it's too late. Why Outer Mongolia with no hams and fewer radios should have the same vote as the USA is absurd. It's time this nation acted like a first-rate power instead of a fifth-rate one. I hope your editorial was read by the people who control whether or not we stay in the ITU.

Ron George K7UL
Phoenix AZ

. . . AND THIS ONE

I have enjoyed my last year's subscription to your magazine, but I cannot renew the subscription.

I am a member of, and support, the ARRL, and will not be a party to an organization that demeans the ARRL viciously in every issue the way your Mr. Green does. (Your cartoon does him justice—all negative.) The ARRL makes mistakes as anyone who tries to do something will do, and I will be the first to say we should point out these mistakes. But the way *73* does this—via Mr. Green's sarcastic attacks *every* month—is not the way.

If you decide to change this part of your magazine, I would enjoy subscribing again.

R. C. Cranford WA4SSI
Wallace NC

10M AM

I have seen quite a few references made to channelized 10m AM operation lately and you have also asked if your readers are interested in this type of operation. I have followed this very carefully and as yet have not read much about it in the letters column of *73*. Rest assured there are hams interested in this, even over here in Germany! I have converted a CB set using the *73* band plan, channel 1 being 28.965, and I monitor this frequency nearly every day of the week. In case any of your readers are interested, I am on the air weekdays from 1700 GMT until about 2200 GMT and on weekends from 0800 GMT until

Continued on page 127

Get into "220" Mobile the Easy Way with Midland

Midland has a pair of proven performers, crystal controlled or P.L.L. synthesized . . . both designed to be easy on the pocketbook

To start with, here's Midland's Model 13-509. It's a compact, rugged mobile with capacity for 12 crystal-controlled channels. The "509" transmits with 10-watt or 1-watt output. Its receiver has a dual gate MOS FET front end with hi-Q resonator and ceramic filters. There are SWR and polarity protection circuits, internal DC filtering and electronic switching. With its jack for optional tone burst and discriminator meter, the "509" has even been the basis for many repeaters.

Midland's choice alternative in "220" is P.L.L. synthesized Model 13-513. Here's advanced design with modular construction and digital frequency readout. It's programmed for 500 frequencies between 220 and 225 MHz, with a 5 KHz shift up giving 500 more . . . and 4 offsets are available for repeater use. The receiver has a multiple FET front end with monolithic crystal and ceramic filters. The transmitter switches for 20-watt, 10-watt or 2-watt output. With automatic SWR and polarity protection, internal DC filtering, electronic switching and a jack for tone burst and discriminator meter, the "513" is a very desirable "220" mobile . . . or base.

Pair either of Midland's "220" mobiles with Midland's trunk/roof mount or magnet mount antennas (Models 18-950 and 18-951) for top-notch performance on the band.

MIDLAND INTERNATIONAL

For more about Midland "220" Mobile, write: Midland Amateur, P.O. Box 1903, Kansas City, Missouri 64141

Carl C. Drumeller W5JJ
5824 N.W. 58 Street
Warr Acres OK 73122

Gourmet Guide To Capacitors

—for that project you have cooking

Electronic experimenters and just about all builders of radio equipment use fixed capacitors in various applications. But how many know how to select the particular type best suited for a proposed use? This article will point out the factors one ought to consider while making a decision as to what type to buy. Of course, price and availability always are of major importance, but sometimes other factors should not be overlooked.

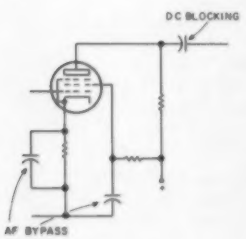


Fig. 1.

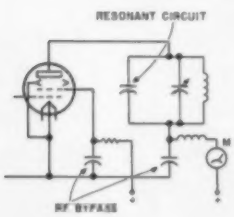


Fig. 2.

Here are some points for consideration for critical applications:

- Capacitance vs temperature
- Insulation resistance vs temperature
- Voltage vs frequency
- Current vs frequency
- Dissipation vs temperature
- Dissipation vs physical size

Add these considerations: What are you planning to use it for? Do you want dc blocking? rf bypass? af bypass? part of a time constant? surge absorption? arc suppression? You might opt for a different type for each one of these applications.

What types of construction does the market offer? Would a wound type do the job you have in mind? Or does it require flat plates of minimum inductance? Must the equivalent series resistance be low? What voltage will be put on it? Must it withstand unexpected voltage surges? Will it have to take the high circulating currents of a resonant circuit?

There's no all-inclusive answer to these many questions, but you can narrow them down to certain categories. Then, answers, or at least suggestions, become feasible.

Let's start with resonant circuits. These call for stability—good capacitance-vs-temperature characteristics. If, in a transmitter, a high-voltage breakdown will be necessary and that transmitter has any appreciable power, an ability to accommodate high circulating current becomes imperative. Satisfying such requirements usually calls for either mica or a special grade of glass as the dielectric. Be sure both voltage and current ratings are adequate. Voltage ratings are easy to come by. Current ratings, especially at the frequency you might want to operate, are not. Nevertheless, current is a critical specification for any capacitor used in a resonant circuit handling more than peanut power.

Next, let's take a look at rf bypass capacitors. These, too, may call for high-voltage capabilities, but seldom do they need to pass heavy current. Usually, low inductance is a required specification. This means short and broad leads, plus proper internal construction. You can buy acceptable rf bypass capacitors with ceramic, mica, polyester, polycarbonate, polystyrene, polysulfone, and polypropylene dielectric. Each

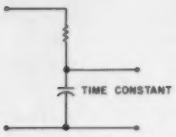


Fig. 3.

of these has some particular characteristic that makes it preferable for some specific use. None is universally superior.

If you're looking for the highest capacitance for a given physical size, then you'd pick a ceramic capacitor with barium titanate as its dielectric. Then you'd have to put up with its variations attributable to temperature, voltage, and frequency!

One of the best of the several "poly" varieties is polystyrene. It, however, has a sharp upper temperature limit of 85° C. Polycarbonate and polysulfone approach polystyrene in merit, even excelling in some respects.

Of course, if that bypass application involved high voltage, you'd opt for mica dielectric. One company, Semtech, offers a ceramic capacitor in voltage ratings of 1, 2, 3, 4, and 5 kilovolts. Their small size would make them appear to be a desirable alternative to micas.

Audio bypasses are much less critical. Although paper and a number of the "poly" types are made in capacitances as high as 10 microfarads, aluminum or tantalum electrolytics are a much more common choice. Of these two, tantalum is the better in all respects other than price.

For dc blocking use, the requirements are largely the same as for rf bypass. Voltage ratings, of course, must be high enough to take care of both the dc component plus the superimposed rf or af component. High insulation resistance is vital in blocking use.

Time-constant application, where holding calibrated values is important, calls for a superior type of dielectric. Polystyrene has an edge over competitors. For very long time constants, it may be necessary to use tantalum electrolytics in order to get sufficient capacitance, even though stability will suffer.

Surge absorption and arc suppression call for capacitors capable of handling momentary loads of both high voltage and heavy current. Not only is the type of dielectric important, but also the interior and exterior construction. The capacitor must be designed to be effective at quite high frequencies, as the spikes of voltage surges are made up of high-frequency components.

Also, it may be desirable

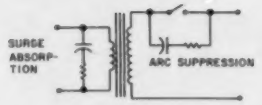


Fig. 4.

to have a self-healing type of dielectric. Metallized polyester (mylar) offers this characteristic. It's not often available in high-capacitance values, though. A few manufacturers offer it in sizes up to 10 microfarads. In all instances, it is important to have a minimum equivalent series resistance. Physical size may be important, too, for the capacitor will have to dissipate the power contained in the surges.

It's hoped that this bit of exposition on the various types of fixed capacitors may help the reader to make the optimum choice when he buys a capacitor for a specific application.■

LETTERS

from page 124

about 2300 GMT. I frequently give calls on the frequency and monitor constantly.

Surprisingly, there is quite a lot of AM activity on 10 over here using low power. There are many local rag chew groups and coverage throughout Europe is quite good at times. Recently, conditions were such that stations in Berlin were heard working mobiles and fixed stations as far north as Hamburg. I hope to work some stateside DX one of these days.

Richard J. Molby
DA1DB/WB7NZG
APO New York NY

SUPER TAPES

Just this past Wednesday I went to Albany NY and took my General exam and passed it. If it hadn't been for those *73* code tapes, I don't think I would have been able to pass the code part. You were right! If it hadn't been for my nerves, I would have gotten 100% copy. As it was, I did manage to get 100% on the code test. Keep up the good work on the mag.

Dave Kessler WB2JUJ
Hoosick Falls NY

DON'T FORGET GOGGLES

With reference to W7RXV's article in the July, 1978, issue of *73* entitled "Instant Engraving—to protect your equipment," I hope readers realize that if they use this method for engraving, they must also protect their eyes. Glowing carbon rods and arcs from such rods emit dangerous ultraviolet rays which will damage the eye. I would strongly suggest to those who can still read this magazine that they wear good quality ultraviolet protective goggles while using RXV's etching method. This is a precaution I have learned in college while using a carbon arc lamp to expose photosensitive circuit boards.

James T. Schug WA2YEI
Middle Village NY

GRIPES

In a recent issue of your fine magazine, you made a comment about the "Canadian" portion of the 20 meter phone band (14.1 to 14.2). I think it might be a little more justified if your phone band expanded to 14.125, leaving 25 kHz as a little breathing room for our 15,000 amateurs.

On another subject, we in Canada are finding, just as you did, that it is almost impossible to fight the ARRL. The League has used its large financial backing to attempt to kill our only national organization (Canadian Amateur Radio Federation) ever since it was devised. How would you feel if, for example, the national organization of Mexico tried to represent the USA amateurs in front of the FCC? Well, that is what the ARRL is attempting to do in Canada. They have gone as far as to call themselves "The Canadian Radio Relay League." I could go on for a whole book, Wayne, but I just wanted to let you know that you weren't the only one with gripes.

Rob Bareham VE3ACY
Ottawa, Ontario
Canada

Write the book, Rob, and let hams know what the ARRL has done in Canada.—Wayne.

Ham Help

I am interested in obtaining my Novice class amateur radio license. Any help would be greatly appreciated. Thank you.

Hugo Harmatz
2 Ferris Ct.
Oakhurst NJ 07755

I would like to exchange technical ideas with anyone interested in the 160-190 kHz band.

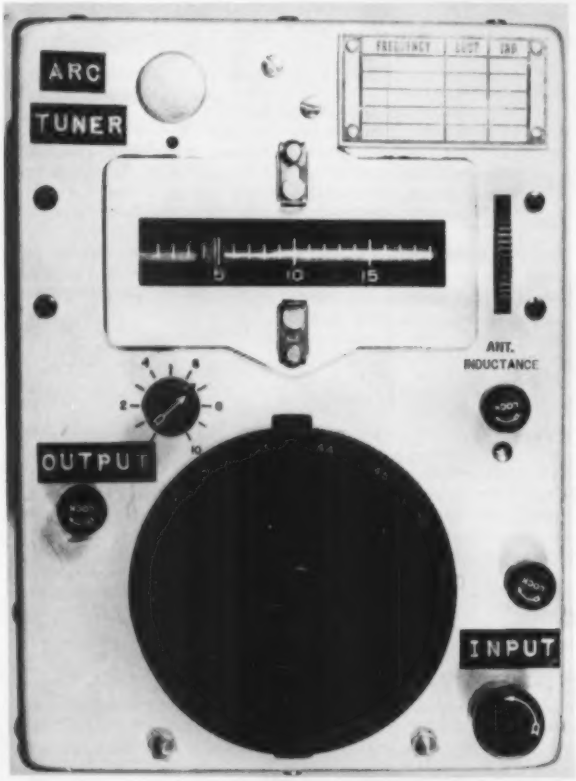
Ted Swift WB7OQQ
Rt. 1 Box 5248
Richland WA 99352

Bob Engle K9QLL
Box 73
Alsey IL 62610

The ARC Tuner

—*rejuvenated surplus*

A recent article on antenna tuners entitled "The London Bus Tuner," *73 Magazine*, June, 1977, provided the final push for this tuner. I believe that it meets the criteria for an inexpensive, yet flexible, tuner for power levels up to 500 Watts and from 160 through 10 meters, depending on the configuration. It also provides for simple packaging and convenience of readout with a minimum of mechanical gimmickry. The only parts needed, in addition to an ARC-5 transmitter, are a 4½" by 6½" piece of Plexiglas™, a 1" piece of 3/8" dowel (plastic or wood), and one or two chassis-mount coax connectors. The ARC-5 is available from Fair Radio Sales, Box 1105, Lima OH 45802, as a BC-457 for $14.95.



Front view of completed tuner.

Most of the configurations in the Bus Tuner article may be used with this setup. Fig. 1 shows the tuner wired in a configuration similar to Fig. 1(c) of the Bus Tuner article and I found this meets most of my needs.

The only special tool required is a bristol wrench needed to remove the gear from the antenna coupling coil and the hardware from the PA padder capacitor. However, a small-bladed screwdriver may be filed down to fit.

The first step is to strip the chassis, leaving only the rotary inductor, PA tuning capacitor, and antenna coupling controls. Save all hardware and parts until the project is completed—the total time required should be less than four hours.

Strip the chassis as follows: Remove top and bottom covers, remove tubes, crystal, antenna relay, and its associated hardware. Carefully remove the antenna binding post and reassemble it so that the parts are not lost. Remove the antenna contact from the end of the rotary inductor—do this carefully as the ceramic threads are fragile. Replace the screw that holds the spring clip on the end of the coil. Remove the PA coil. Carefully remove the fiber gear from the PA coil—use solvent (or nail polish remover) to loosen the two setscrews before trying to remove them. Set the gear and setscrews aside—these are an important part of the finished product!

Remove the oscillator cover, padder capacitor, and coil. To remove the coil, remove the three screws holding it, lift up gently, and cut all the leads going to the bottom of the coil.

Turn the unit over and remove the pin (I used a small finishing nail as a punch) from the flexible shaft at the front capacitor. Save this pin.

Remove the rear variable capacitor. Remove the PA padder capacitor (second variable from the front).

Now remove the tube sockets, rear power plug, relay, all wires, the resistor

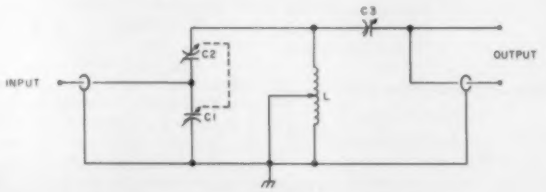
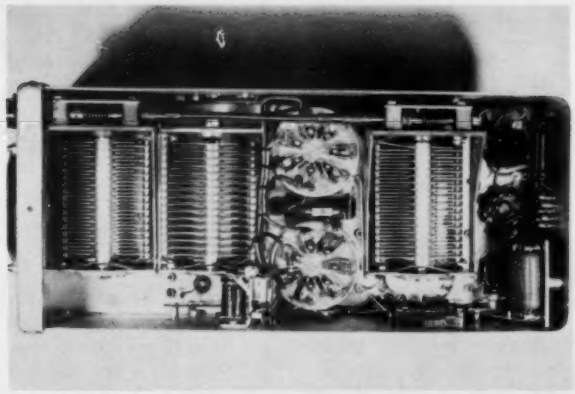


Fig. 1. ARC tuner schematic diagram.

Top view of unconverted ARC-5.



Bottom view of unconverted ARC-5.

on the rear panel, and the bracket that held it. Also remove the mica feedthrough and the widgets that hold the oscillator coil cover in place. The transmitter tube sockets, feedthroughs, and power plug on the rear apron must be "persuaded" off with a hammer and screwdriver.

Modify the chassis as follows: Cut out a 4" by 4" section of the top of the chassis starting about 3/8" in front of the tube socket holes at the rear of the chassis. Part of this hole will include the space left by removing the PA tube sockets.

If you want coaxial output in addition to single-wire feed, make a 5/8" hole on each side of the power plug hole on the rear apron—one hole for the coax connector, the other for the antenna binding post. Of course, the post can be used in its original hole if desired. Remove the large hole plug from the side of the chassis and use it to fill the hole in the front panel left by the antenna post.

Remove the locking hardware from the PA padder capacitor. Use solvent (or nail polish remover) to loosen the setscrews.

You must now drill out the fiber gear to fit on the shaft of the PA padder. Do this very carefully, clamping it in a vise on the metal part only. DO NOT drill all the way through. A mistake might be rectified with epoxy glue.

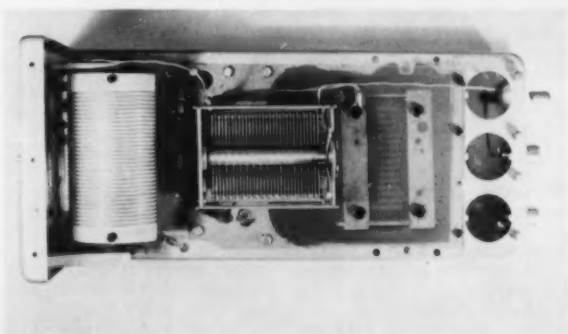
Mount the gear on the PA padder capacitor. Lubricate the bearings on this capacitor as they will be a bit stiff (WD-40 works fine).

Now, place the 4½" by 6½" piece of Plexiglas on top of the chassis and place the PA padder on it so that the gear meshes with the gear on the antenna coupling control. Mark the position of the capacitor and the mounting holes. Remove the Plexiglas and drill these holes. Using the Plexiglas as a template, drill two large (5/8" or so) holes in the chassis to provide clearance for the mounting screws on the front of the PA padder capacitor.

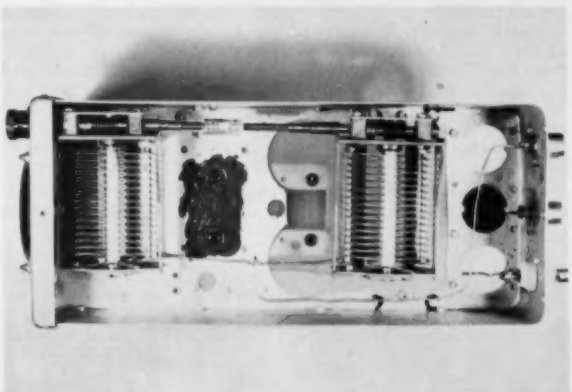
Mount the Plexiglas on the chassis and mount the PA padder capacitor. It should operate freely with no binding as the antenna coupling control is operated through its range. If the mounting holes are made slightly larger than the screws, the capacitor may be adjusted to provide a good mechanical fit.

The next step is to modify the flexible coupling shaft. Remove the shaft from the capacitor by removing the pin. Make a mark 1" from one of the metal ends of the shaft and 1¼" from the other end. Measure from where the metal coupling connects to the flexible shaft material. Solder around the shaft at each mark—this prevents the shaft from unraveling. Then cut the shaft to the marked length. Make the insulated coupling by drilling a 3/8" deep hole in each end of the 1" long piece of plastic or wood dowel. Use a number 25 drill.

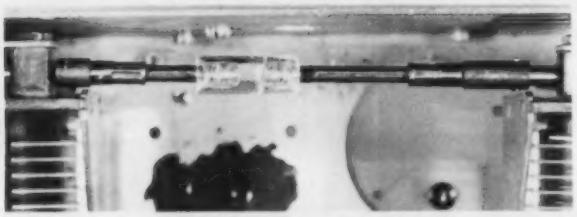
Apply epoxy glue and force each end of the flexible shaft into the coupler. While the glue sets, remove the third fastener on the right side of the bottom plate—this is a safety measure to prevent the



Top view of completed tuner.



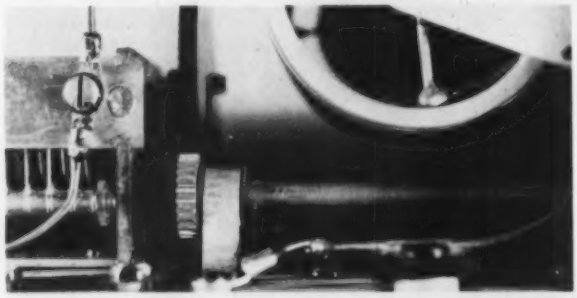
Bottom view of completed tuner.



Flexible-shaft coupler details.

capacitor from arcing to ground.

Reassemble the flexible shaft to the capacitor and put it in place in the chassis. Set it slightly further away from the wall than the original mounting position (the flexible shaft will make up for the misalignment). Drill the holes and mount the capacitor.



Padder gear assembly details.

Make sure that both capacitors are set the same before replacing the pin. The capacitors should now track as the frequency control is tuned through its range.

Mount the antenna post and one coax connector in the 5/8" holes on the rear apron. Mount the second coax connector in the power connector hole. Use a round file to file notches to clear the mounting hardware. Also mount a bolt or binding post on the rear apron for a ground connection.

I used the wire from the PA and oscillator coils to wire the unit. Ground both ends of the roller contactor using solder lugs and the existing holes. Place a solder lug under the screw holding the spring clip on the end of the roller inductor. Also place a solder lug under one of the mounting screws on the rear capacitor.

To use the tuner, set the capacitors to maximum (lowest frequency on the dial and 10 on the coupling indicator) and apply only enough power to get a reading on the swr indicator. Adjust the coil and then the capacitors for 1:1 swr. Record the tuner settings on the handy chart provided on the front of the unit.

If you buy a used ARC-5 that has been sitting in a barn for a few years, a thorough cleaning will be in order. Use a pencil eraser to clean the rotary inductor, the rotary contactor, and the rod on which the contactor rides. Lubricate the capacitor bearings and the drive shafts and gears.

I would like to thank K9OIC for testing the various models of this tuner and for providing unflagging support for this project. ■

OSCAR Orbits

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

Oscar 7 Orbital Information

Orbit	Date (Sept)	Time (GMT)	Longitude of Eq. Crossing °W
17355 Bbn	1	0011:41	61.9
17368 Bbn	2	0105:56	75.5
17380 Abn	3	0005:19	60.3
17393 Bbn	4	0059:36	73.9
17406 Bbn	5	0153:53	87.5
17418 Abn	6	0053:14	72.3
17431 Bbn	7	0147:31	85.9
17443 Bbn	8	0046:52	70.8
17456 Abn	9	0141:09	84.4
17468 Bbn	10	0040:29	69.2
17481 Bbn	11	0134:47	82.8
17493 Abn	12	0034:07	67.7
17506 Bbn	13	0128:25	81.3
17518 Bbn	14	0027:45	66.1
17531 Abn	15	0122:02	79.7
17543 Bbn	16	0021:23	64.5
17556 Bbn	17	0115:40	78.1
17568 Abn	18	0015:01	63.0
17581 Bbn	19	0109:18	76.6
17593 Bbn	20	0008:39	61.4
17606 Abn	21	0102:56	75.0
17618 Bbn	22	0002:16	59.9
17631 Bbn	23	0056:34	73.4
17644 Abn	24	0150:51	87.0
17656 Bbn	25	0050:12	71.9
17669 Bbn	26	0144:29	85.5
17681 Abn	27	0043:49	70.3
17694 Bbn	28	0138:07	83.9
17706 Bbn	29	0037:27	68.8
17719 Abn	30	0131:45	82.4

Ham Help

Help! I built the noise bridge of Floyd Jones W6DOB (*73*, April, 1978), but *nobody* has *miniature 360 pF* variable capacitors anymore. The junked radios I have used are either old, full-size ones, bigger than the rest of the components put together, or minis that are short by 100 or so pF. I would appreciate hearing from someone with a larger junk box. Radio Shack no longer carries theirs, which were pretty inexpensive.

I am also trying to locate surplus or used components for a transmatch—I don't believe current prices for new coils and capacitors!

Walter Kimmel
Box 56
Ponsford MN 56575

I am interested in hearing from other hams and computer enthusiasts in the northern New Jersey area who are interested in starting a GMRS (formerly Class A CB) repeater. I have station authorization and an excellent site.

Tony Loving WB2TMX
72 Shepard Avenue
Teaneck NJ 07666

I am turning to the amateur radio community as my only possible route to reach a fellow with whom I was close friends over 10 years ago, but haven't heard from in some time. I don't know his present call but he got his Extra about 1968. His name was Philip Staub, of the Benton Harbor, Michigan area, in his high-school days. I would very much appreciate hearing from him directly or from any acquaintances having his current mailing address or phone number. Thanks for your service.

James Finckbone
PO Box 6464
Orlando FL 32853
(305)-894-7814
(305)-275-1607

I acquired an RT-654A/TRC-77, government issue, crystal-controlled CW transceiver at the BirmingHamfest in May. I'd be very grateful to anyone who could clue me in on how the unit operates, or who has any manuals on this gear. Thank you.

Bob Howle WA4ZID
2710 Niazuma Avenue, Apt. 1
Birmingham AL 35205

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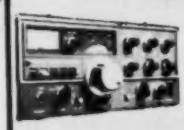

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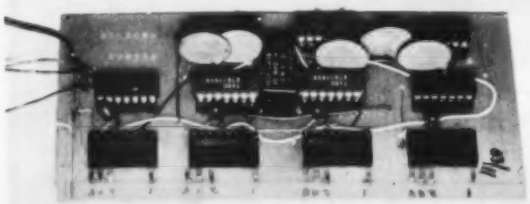
Julian N. Jablin W9IWI
9124 North Crawford Avenue
Skokie IL 60076

Home-Brew Circuit Boards

—*cheap and simple*

Hand wiring circuit boards is a not-uncommon means of making quite satisfactory boards which can match in effectiveness, if not always in appearance, those which have been etched. It is the purpose of this article to pass along some ideas which have worked for me to make the job easier and/or more economical.

Some projects in which the usual procedures of applying a resist (mechanically or photographically) and then etching do not pay, include: one-of-a-kind devices with complex patterns, those for which commercially-available boards are not available or are inordinately expensive, those in which the builder wishes to make changes from a published design, and those for which the builder does not have facilities for applying resist, etching, and drilling. Of course, there is always the tinkerer who stubbornly insists on doing a job in his own way, trying something new and different from the established methods of handling a project.



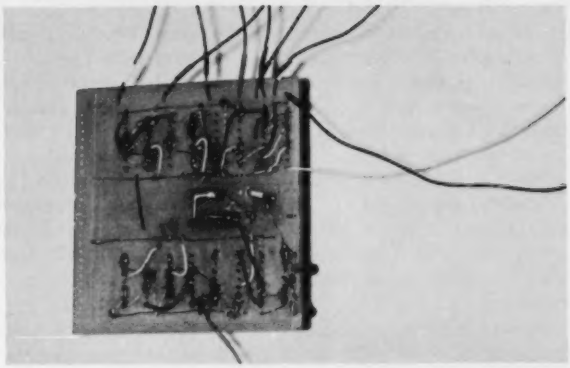
Jumper wires on the component side of the board are useful at times to avoid too much clutter on the foil side. Push-in terminals (Radio Shack 270-1392) were used here as junctions for anchoring the light-colored 5-volt line, and as soldering points for connection to the IC sockets on the other side of the board. Terminals are also used along the front edge of the board to bring out leads which will later be soldered to them. Board here is 2-1/2" × 5-1/4".

One has to start with a board of some kind. The phenolic, prepunched board sold by Radio Shack (catalog 276-1395) for 99¢ is good, given the shortcomings of phenolic. It is punched .100 × .100 inches for IC sockets and other small components. This is a 2-3/4" × 6" board and two larger sizes are also sold. You will probably need to cut boards to size for specific use; a fine hacksaw or model railroad track saw works well with phenolic or epoxy boards.

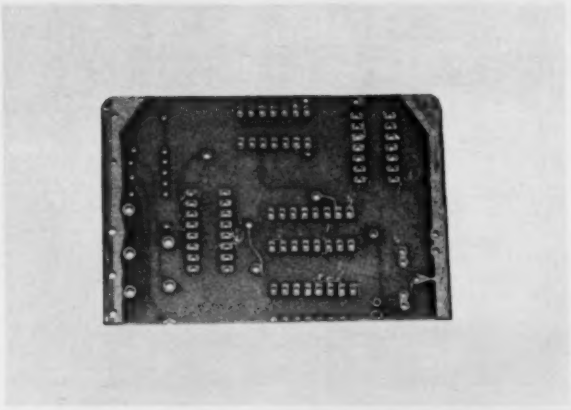
Higher-quality board, usually glass epoxy, is available as surplus cards from computers and other devices. The trick here is to buy boards which have high-density packaging so that there are many ICs mounted on them. This leaves a lot of holes from which to select when you come to arranging your own layout. I once found an 8-1/2" × 14" board which included 82 ICs, neatly arranged in rows, plus a 1.8 MHz crystal and associated transistors, capacitors, and resistors, all for $1.75. A better buy was an etched board without any components for a couple of cents. Cut into pieces (after the components were removed from the first board), these boards have provided numerous smaller boards for various projects.

A surplus board must be cleaned off. Removing the capacitors and resistors is an easy trick, even if you want to be careful enough to use them again. Slip a small screwdriver under the component, heat one lead on the other side of the board, pry up gently, and repeat with the other lead. Test all items before using them again. You don't know *why* the board was declared surplus.

ICs are another matter. It is almost impossible, without a special soldering iron, to heat seven or eight pins all at once. The solder can be removed with one



Bare wire can often be used to an advantage, as shown in the thin horizontal lines on this board. The center two lines are the 5-volt dc supply; lines at top and bottom edges are common bus. Leads coming off the board also show small sleeves of colored insulation slipped on for color-coding. Board is three inches square.



Section cut from a larger computer board and then etched clean, leaving pads for anchoring IC sockets, foil strips on edges for ground bus, as well as other leads which seemed to be useful. Board is 2" × 3½".

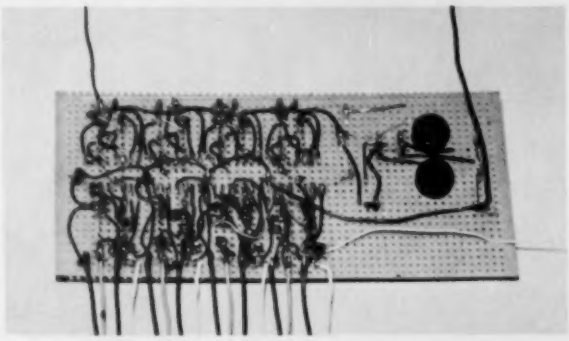
of the de-soldering "wick" products on the market. I use small size shielding from unwanted mike cable or the like, dip it in soldering paste, lay it on the line of pins, and heat it with an iron. It sucks the solder up so that the IC can be pried off, one side at a time. The heat is likely to ruin the ICs, of course, but these are usually house-numbered and you do not know what they are; thus, they are of no use to you anyway. If you have facilities for determining IC types, you would probably be testing the devices at the same time, so you can discover what they are and whether they are good all at once.

Now you have a board with a lot of empty holes and connections among them, and the next job is to remove the excess foil. The quickest and easiest way to do this is to dump the board (or any portions that you have cut off for use) into PC etchant and let it do its dirty work. Dab spots of resist (fingernail lacquer, paint, candle wax, etc.) on the pads at each IC location. This will permit the pads to remain while everything else is etched away, and will give you something to anchor the IC sockets to when you begin soldering your own circuit. It may be handy to save a ground (common) bus, or pads for external connections to the board, if these will not get in your way. I have tried to compare the pattern on a board with the pattern of a circuit on which I am working, in an effort to save any connections which may be useful, but I do not recommend this. Especially on a double-sided board, or in a complex circuit, it is the road to instant insanity.

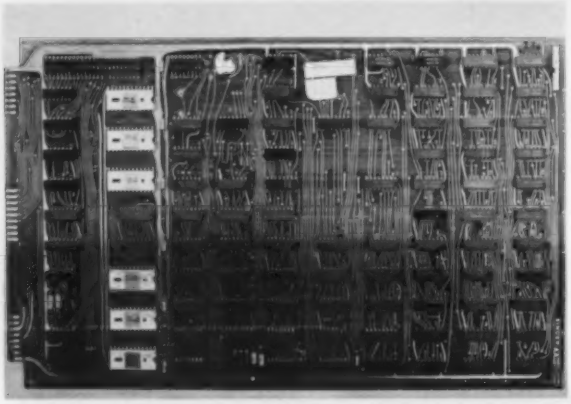
Follow the safety notes and instructions on the etchant bottle carefully. The stuff stains hands and clothing, and is definitely injurious to eyes and other sensitive skin areas. It is convenient to have a pail of water handy to dip the board into as a rinse to check things as you go along. Likewise, it is worthwhile to use a pair of plastic tweezers (photo print tongs, for example) to handle the board in the solution. Do not bother to heat the solution according to the instructions unless you are in a hurry. When all of the unwanted foil has etched away, wash the board, clean off the resist with chemical solvent, a "Rescue" pad, or with fine steel wool, and wash the board again.

I am a great believer in IC sockets because I am not a believer in the specs of the bargain ICs I buy. Sockets are cheap—30¢ or less by mail—and they save hours when you have to change the ICs around to find which ones do not work. Molex sockets are a dubious bargain. They do not slip into the holes easily, and, after a few insertions and removals, they are not reliable. At first glance, it would appear that IC sockets with long pins for wire-wrap applications would be easier to solder to, but I find that the extra length gets in the way of precision work and I wind up with two or three pins soldered together.

A word about the holes in the board. You will find many of them plugged with leftover solder, and you will find need for a few where the original manufacturer neglected to foresee your requirements. Stop at your friendly neighborhood hobby shop and buy a couple of fine drills; number 62 or smaller is good. At the same time, if you do not have one, get a cheap pin vise. With this combination, you can ream



Circuit built on a 3" × 6" Radio Shack board 276-1395. It looks like a rat's nest of wiring, but color coding and a little care made everything come out right. This kind of sloppy wiring is permissible only when there is no rf or audio circuitry involved.



One example of the "raw material"—a surplus computer board measuring 8-1/2" × 14". ICs are not removed until a smaller piece is hacked out for a specific purpose. More than three dozen resistors, diodes, capacitors, and transistors were carefully taken out for future use. A board such as this would make an excellent "mother board" for a project which is made up of several smaller modules.

out plugged holes and drill new ones. You can do this while holding the board in one hand and the pin vise in the other, and thus make holes after you have begun mounting components. You cannot do this safely with a hand drill or drill press.

At the hobby shop, you can also get a small egg-beater-type hand drill made by X-Acto® which is light and, if handled carefully, will not break too many of the little twist drills. However, buy several twist drills at a time as they go fast!

The wire that you use should be as fine and as flexible as you can find. Teflon™ insulation is good for resisting any tendency to shrivel up when the heat of soldering hits it. Again following the surplus route, I have had luck in finding cables made up of many leads of fine stranded wire, number 24 or 26 or so, with various colors of insulation, which I have separated into individual leads. Solid wire is a nuisance.

Wiring this kind of board by hand is admittedly no fun. There are too many repetitious operations, since so many ICs use the same connection schemes. After a while, it becomes a question of "Did I wire pin number five and which pin is number five?" If you have an etching pattern for the device, make a Xerox® copy of it to follow, inking in each connection as you solder it. If not, do the same on a circuit diagram. Yes, this is the same way that beginners did it in the old days of metal chassis and 240-volt transformers, but it works.

Solder two or three corner pins of each IC socket to the pads which you thoughtfully left on the board. This will hold the sockets in place while you get down to serious business. Then, again following the old octal socket tradition, wire in the "high-voltage" leads first, then the ground (common) leads. After that, tackle the rest of the wiring.

As with any other complex wiring job, color coding will help keep matters straight so that you know where you are. I use yellow or red for Vcc, black for common, and one or two additional colors for other leads. Leads coming off the board for interconnection to other boards, switches, etc., must be color-coded or you can get hopelessly lost. If you do not have enough colors of insulation for this, use bits of colored insulation from larger sizes of wire, slipped on the leads and snugged up against the board end of the leads. And make notes as you proceed, reminding yourself of what each color indicates.

You will want a wire stripper, and the small plier-type with a notch to cut the insulation, but not the wire, works well. Set the closure adjustment carefully, since you cannot afford to take any strands of wire off with the insulation. There is not that much wire! Other handy tools include a couple of small screwdrivers, small long-nose pliers, a small pair of diagonal cutters, a small soldering iron, and possibly a small file. The key word in the whole operation is "small."

Preform the leads before you solder them in. Strip about 3/8 inch of insulation, tin the end of the wire, cut the lead to approximate size, then strip and tin the other end. Bend a hook in each end small enough to fit snugly on the IC socket pin and solder it on. Where leads are in the clear, with no possibility of shorting to other leads or pins, you can strip and tin a longer piece of wire. Bend a hook in it as before, solder it to a pin, pull it against whatever else it is to be connected with, solder it, and clip off the excess. This speeds things up a bit. If you have an etching pattern, try to follow it fairly closely with your wire leads. The designer may have had some reason for lead placement.

A circuit board wired in this manner will probably win no prizes for neatness, and some unkind friends may compare it with a rat's nest. But the system works and is a suitable substitute for drawing artwork, sensitizing, exposing, developing, etching, and drilling boards, which may be beyond the experimenter for one reason or another. ■

Unused holes which remain after etching a board clean may be used to anchor leads and other components. On this 2-1/4" × 3-1/2" scrap of board, a strip of foil was allowed to remain as a ground bus. Etchant crept under the resist, leaving a ragged edge, but enough foil was left to be useful.

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73 Reveals Bias!

—transistor operation exposed!

Much mystery is attached to what, in most instances, is quite a simple subject. That subject is the biasing of bipolar transistors.

Let's look at a transistor in a circuit with no biasing, as in Fig. 1. As it stands, no collector current will flow unless, of course, the collector voltage is raised past the breakdown point. We'll consider operation only under normal voltages. If you were going to use that transistor in class B service, whether radio frequency or audio frequency (we'll ignore distortion!), it will operate without bias. It's often used that way. You could apply some bias between the emitter and the base, being careful to have the opposite polarity on the base as on the collector, and operate it class C. However, you'd gain very little over class B operation. The transistor might run a little cooler, the radio frequency power output (for a given power input) might be a trifle greater, but you'd pay a price. That price would be a much greater generation of harmonics. At their best, transistors are notorious generators of harmonics. Many users hesitate to encourage them by biasing to class C.

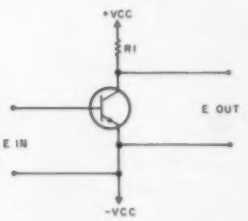

Fig. 1. Transistor with no bias provided.

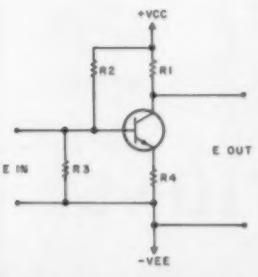

Fig. 2. Typical transistor biasing arrangement.

But suppose you want to run that transistor in audio frequency service, operating in class A. Now you're concerned with getting a maximum voltage swing between collector and ground (presuming the "common- or grounded-emitter" configuration) while maintaining precisely the same waveform at the output as at the input, differing only in magnitude. This calls for biasing —not just any biasing, but careful biasing, with each move made to accomplish a desired result.

Let's look at Fig. 2. Note that three more resistors have been added. R1 remains between collector and +Vcc. R2 has been added between +Vcc and base. R3 is connected between emitter and −Vee. R4 goes between base and −Vee. The numbers assigned to these resistors are not haphazard. They're assigned in order of importance. The circuit will not work without R1. It will not work in class A without R2. It will work better in class A with R3. And the transistor derives some protection from R4.

What should the values be for these resistors? Really, there's nothing sacred about their values. You start out by selecting some figure for R1. It can be just about anything between 1k and 20k Ohms. Let's say 5k Ohms. Now you could toss in R2, making it some value large enough to permit only a moderate flow of current through R1, but never over half the rated collector current. The circuit would work, but its long-term and short-term stability would be poor and there'd be a high probability of audio distortion. To make the circuit more stable and to lessen distortion, you'd need to add R3. Its value, however, is affected greatly by R4 and R2. Let's consider R4 first.

R4 is in the circuit for two reasons. One is to lessen the chance of thermal runaway. As a transistor warms up (for any reason at all), its collector current increases. This causes it to get warmer, which pushes the collector current even higher. You can see the outcome of such a rat race. To halt the rat race, R4 is inserted. As the emitter-collector current goes higher, so does the IR drop across R4. The polarity of this drop is such that, applied between base and emitter, it tends to reduce the collector-emitter current. This, to a great extent, cancels the effect of heat on the transistor.

There's another, but less important, effect. By putting a linear resistor in series with a nonlinear resistor (the transistor), variations of the characteristics of one resistor to another are, to some extent, smoothed out. This is

important to a manufacturer but makes little difference to a one-of-a-kind builder.

What resistance for R4? There's a wide latitude. Keep it less than 10 percent of R1. If you made R1 5k Ohms, try 200 Ohms for R4. With both R1 and R4 established, you're ready for serious consideration of R3 and R2. Start with R3. Just how heavily do you want to load the device (amplifier stage, microphone, etc.) driving this particular transistor? Keep in mind that the base-emitter junction resistance is going to be quite low, so there's no need to try for a high input resistance. So just pick some value around 2k to 5k Ohms.

Now you're ready to tie down the all-important value of R2. There's no way you can make an accurate guess for R2. Oh, you can say it'll probably be between 5 times and 10 times R3, but such an estimate will not ensure maximum undistorted output. There's just one way of doing that, and that way entails the use of an audio frequency sine wave generator and an oscilloscope.

Connect the equipment as shown in Fig. 3. Apply a very small audio frequency voltage to the input and observe the output on the scope. The image should be a sine wave. Now increase the input voltage until the scope waveform shows a flattening of one peak, positive-going or negative-going. Adjust the resistance of R2 to restore the waveform to an undistorted sine wave, then increase the input voltage until distortion shows again. Repeat this sequence until the waveform shows equal, simultaneous flattening on the positive-going and negative-going peaks. Measure the resistance of R2 and place a fixed resistor of that value in the circuit. Now you have a class A transistor audio amplifier stage custom-trimmed for maximum undistorted output!

If you have an acute ear tuned to detect audio distortion, you might make that final adjustment without a sine wave generator and an oscilloscope. A nonchalant disregard for niceties also helps! But for near perfection, follow the suggested procedure. If you're concerned with a transistor in class A radio frequency service, the procedure is equally effective, provided, of course, that you maintain equal loads for both test and use conditions. An rf stage adjusted in such a manner will be less susceptible to being driven into distortion by a strong signal near the desired signal.

All in all, it's well worth your while to set the bias correctly for a transistor stage operating in class A.■

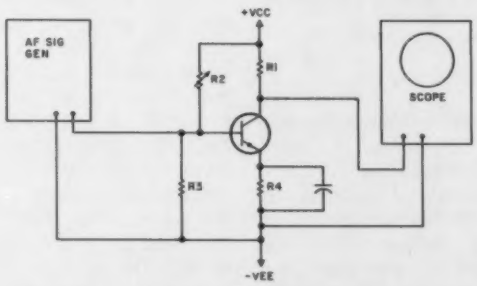

Fig. 3. Test setup for bias adjustment.

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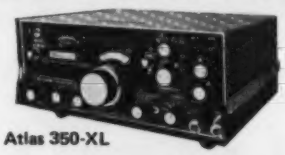

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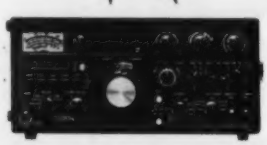

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—part X: Realistic's Mini 23

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The CB boom is just about over. The suppliers are trying to unload warehouses full of new 23-channel CB radios at any price the market will pay. In many instances, the CB antenna will cost more than the radio – amazing but true.

I was in the local Radio Shack store and noticed that the new Realistic Mini 23 CB radio was selling for $29.95. This had to be a bargain, as this radio normally sold for $109.95. I thought this radio would be an excellent candidate for converting to ten meter AM, and, at that price, I could butcher the radio all I wanted to and still not feel bad about it. Let me say at this point that, although I think I made a good buy for the amount of electronics I was getting, I have found out that there are better deals to be had. The used CB market is virtually nonexistent and an enterprising ham can find a broken CB rig for $5.00 or less. At these prices, it will be hard to go wrong when purchasing a CB rig for conversion to ten meters.

With new two meter rigs costing $200.00 and more and new CB rigs selling for one tenth of that amount, it should not be long before ten meter AM is just as popular as two meter FM. All that is needed is a little coordination to keep everyone on the same frequency.

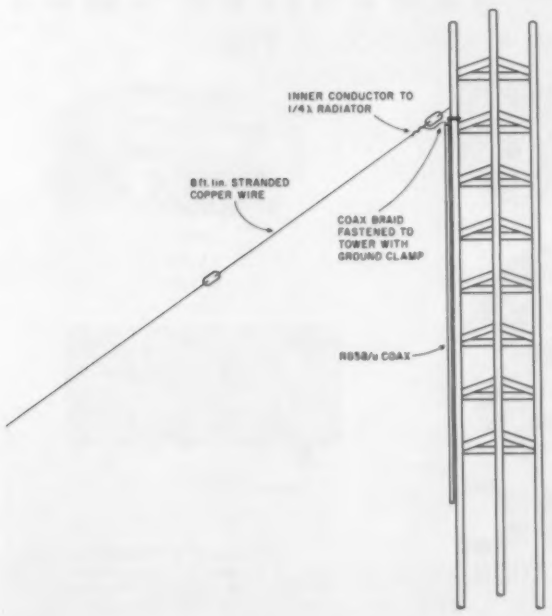

Fig. 1.

Frequency Conversion

Upon investigating the schematic of the Mini 23, I noticed that the frequency scheme for obtaining 23 channels was simply heterodyning any one of six master oscillator crystals against any one of eight local oscillator crystals to obtain the desired frequency. The local oscillator crystals range from 10.150 MHz to 10.180 MHz and 10.595 MHz to 10.635 MHz in 10 kHz steps. The master oscillator frequencies range from 37.600 MHz to 37.850 MHz in 50 kHz steps. In order to come up with a workable plan and in order to purchase the fewest number of crystals, I decided to change the frequency of the master oscillator by 2.035 MHz. This puts channel 1 on 29.000 MHz. This is a nice round number, and it seems that the higher frequencies formerly were used for AM operation. This is accomplished very easily by changing the crystals as shown in Table 1. The new crystals can be purchased from International and other manufacturers for around $4.95 each. This puts the rig on frequency in the ten meter band.

Transmitter Alignment

The transmitter section is peaked up using a VTVM and a wattmeter and dummy load. The probe of the VTVM is connected to the base of Q12, and the oscillator is peaked for maximum output by adjusting T10, T11, and T12 for maximum voltage on the VTVM.

The driver is peaked by connecting the VTVM probe to the base of Q14. Once again, key the mike and then adjust T13 for maximum voltage, and next adjust T14 for maximum voltage on the VTVM. This peaks up the driver section. At this point, some rf output should appear on the wattmeter.

Tune the final by adjusting T15 and T16 for four Watts output on the wattmeter. Do not try to tune the final for maximum output on the wattmeter. The transistor will put out more than seven Watts but, in order to do so, will pull excessive collector current, and the transistor will not hold up to this abuse. The final transistor will open. Take my advice and tune for no more than four Watts out. I know because I learned the hard way and now am using a replacement final transistor.

Receiver Alignment

The receiver can be aligned by using a signal source such as your regular station transmitter tuned to 29.000 MHz and fed into a dummy load or any other suitable weak signal source, such as a nearby ham transmitting on 29.000 MHz. The Mini 23 does not have an S-meter, so I connected the VTVM probe to diode D3, which is the AM detector. It then becomes a simple matter to tune T2, T3, T4, T5, and T6 for maximum voltage on the VTVM. This completes the conversion, and the rig is now ready to go on ten meters.

Antennas

For mobile use, I took a used base-loaded mobile CB antenna and simply started

trimming the whip until I reached an swr of 2:1 while operating on ten meters. On the whip I was using, I took a little more than two and a half inches off. This will vary with different types of mobile antennas, of course, and a good method is to insert the swr bridge in line and trim until a good match is obtained. The frequency change of 2 MHz or so should work out okay with most mobile whips that are base loaded.

For a base station setup, any existing ten meter antenna could be used, even a trimmed down CB ground plane. I wanted an independent rig and did not want to tie up my ten meter beam with the little rig, so an extra ten meter antenna was a must. I finally decided on the sloper-type antenna shown in Fig. 1. This antenna is easy to install, is small, is cheap to build, and is vertically polarized for working mobiles. The sloper should be cut for the middle of the group of frequencies you are using. In my case, it worked out to be eight feet and one inch for just a little below 29.000 MHz. The inner conductor of the coax feedline is attached to the quarter wavelength radiator, and the braid of the coax is clamped to the tower leg using a ground clamp. This system works quite well and cuts the length of the sloper in half.

Results

The ten meter AM rigs compare very favorably with the two meter rigs. The cost is drastically lower, but range seems to be about as good. Mobile-to-mobile coverage is about three miles, and mobile-to-base coverage is six to seven miles. With base station-to-base station contacts running four Watts output and sloper antennas up forty feet at both ends of the path, consistent ground wave coverage of better than 20 miles is maintained. Indeed, it seems that ground wave on this band is about equal to line-of-sight paths on two meters. This is a great club project to bring all those members back together on some common ground. It is also a good project for a couple of guys who just want a little privacy to discuss the stock market or whatever. For under $60.00, this is a good way to keep ten meters alive. See you on ten AM. ■

Crystal	From	To
X1	37.600 MHz	39.635 MHz
X2	37.650 MHz	39.685 MHz
X3	37.700 MHz	39.735 MHz
X4	37.750 MHz	39.785 MHz
X5	37.800 MHz	39.835 MHz
X6	37.850 MHz	39.855 MHz

Table 1.

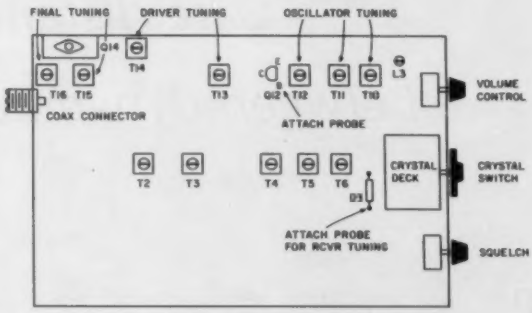

Fig. 2. Realistic Mini 23, bottom view.

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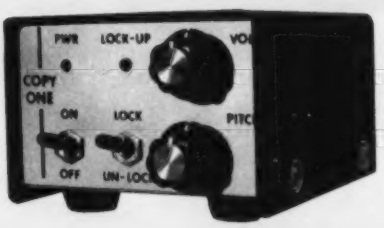

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The sign says, "DANGER—BLASTING, Turn Off All Radio Transmitters." What are the hazards, and how do they affect you as an amateur radio operator? The fact is that dangers do exist, and the average ham might encounter them from time to time, so let's take a brief look at how to recognize and avoid them.

First of all, this article is not intended as a text for the ham who is a commercial user of explosives. He already knows his business in far greater detail than I will go into here. On the other hand, most of us occasionally come into the proximity of explosives through visits to (or near) construction sites, or perhaps on a farm or ranch. For that matter, one might pass quite close to a blasting site as he simply travels along a public road. These are the occasions where potentially dangerous situations might arise, and these are the situations we would like to avoid.

In the way of background, you should know how explosives are categorized under three rather broad classifications:

1. Primary explosives (also called igniters or detonators) — these are quite sensitive to heat, flame, and shock. This category includes the various percussion, fuse, and electrical blasting caps.

2. Secondary explosives — these are less sensitive to outside influences and are normally detonated through the use of blasting caps. Dynamites fall in this category.

3. Tertiary Explosives — these are quite insensitive and include certain industrial chemicals and compounds. Detonation can normally be triggered only through the use of a secondary explosive. (But accidental detonation is still possible. It was a load of tertiary explosives that accidentally blew up in Texas City, near Galveston, in 1947, killing 561 people and completely destroying the town.)

As you might suspect from the above, secondary and tertiary explosives are not by themselves sensitive to rf energy. Certain primary explosives — and, in particular, electrical blasting caps — are quite sensitive, however, and the accidental detonation of a cap will in turn detonate all of the secondary and tertiary explosives in the vicinity.

The electrical cap consists of a small piece of resistance wire imbedded in an explosive charge. A pair of wires lead out from the cap for connection to the firing circuit.

Fig. 1 shows how the wires, when unconnected, can act as a dipole antenna. With sufficient rf energy induced into the leads, the internal resistance element will heat to the firing point.

Shorting the wires together (Fig. 2) or placing the cap in a completed firing circuit does not necessarily improve the situation. In fact, this creates a loop antenna, which in some cases is even more efficient than the dipole. This can be true no matter how close to the cap the wires are shorted. If you don't believe it, bend a 4-inch piece of wire into a loop and solder the ends to the two contacts of a #47 bulb (Fig. 3). Then move the loop up and down your transmission line or in front of your antenna with the transmitter on, and watch the bulb light up.

A number of years ago, I observed an accident at a MARS station which underscores the danger I am discussing. A military photographer had come to take some pictures for the base newspaper and had outfitted himself with a pocketful of flash bulbs. As he strolled under the antenna system, several of the bulbs went off, much to his dismay. It should be realized that the firing currents of blasting caps are not only similar to those used

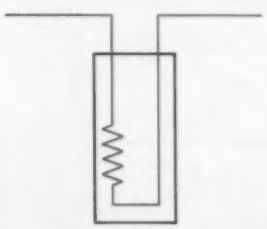

Fig. 1.

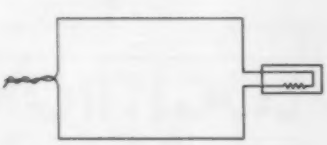

Fig. 2.

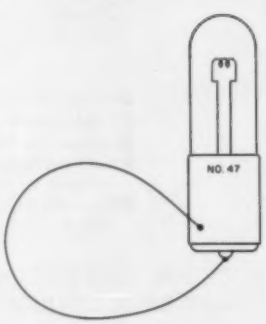

Fig. 3.

for flash bulbs, but, in addition, the caps have wire leads which act as fairly efficient antennas.

The fundamental question then is, at what distance from a blasting site does it become unsafe to use a transmitter?

The minimum safe distance is a function of both the transmitter output power and the frequency of operation. Explosives manufacturers have determined that electrical caps (for unknown reasons) tend to be more sensitive to rf in the vicinity of 21 MHz, but only slightly less sensitive at other frequencies. For all practical purposes, the frequency of operation is unimportant.

Table 1 gives the minimum safe distance between the transmitter and the closest part of a blasting circuit. Remember that, while the charges may be set some distance away, the wires of the blasting circuit could be routed anywhere – very close to a road or parking area, for example. Fortunately, due to the fact that the rf energy decreases away from the transmitting antenna according to the inverse square law, only very high ERPs require extreme separation distances. Such high effective radiated power is most likely to be encountered only at an amateur's fixed station, and blasting operations are not likely to occur anywhere near a residence.

Effective radiated power (ERP)	Minimum safe distance between transmitting antenna and closest part of electrical firing circuit	
Watts	Feet	Meters
10	100	30
50	225	70
100	325	100
250	500	150
500	675	200
1,000	1,000	300
10,000	3,000	915

Table 1.

We can see that the primary danger arises from the use of mobile and hand-held transmitters at or near a site where blasting operations are underway. It is here that a transmitter can easily be inadvertently carried within a few feet of a live firing circuit, and it is here that one must be especially cautious. Remember, the explosive charge may be some distance away, but you might be standing right on top of the firing circuit. An accidental detonation would probably not only kill the workers preparing the charges, but would probably also kill the operator of the transmitter, unless by chance he happened to be at the extreme far end of the circuit.

The best rule of thumb to follow is simply to refrain from transmitting at any location where you have the slightest suspicion that blasting operations might be carried out, or where blasting supplies might be stored. Certainly, if you see a warning sign, shut down the transmitter immediately.

The hazards I've mentioned are not a daily concern to most amateurs, but they do arise at one time or another for almost everyone. An informed ham is a safe one, and, with the basics discussed here, he will know when, and when not, to operate his radio transmitter. ■

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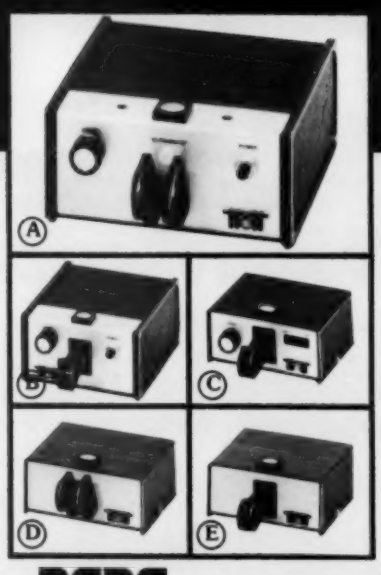

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(B) TEN-TEC KR20-A Electronic Single-Paddle Keyer — $69.50

Factory adjusted actuation force for smooth keying; factory set weighting factor for smoothness and articulation. Self-completing characters. Adjustable speed (6-50 wpm). 500 Hz side-tone oscillator. Built-in "straight-key" button. Operates on 117 VAC, 50-60 Hz or 6-14 VDC.

(C) TEN-TEC KR5-A Electronic Keyer — $39.50

Same as KR20-A less side-tone and power supply. Operates on 6-14 VDC.

(D) TEN-TEC KR1-A Deluxe Dual Paddle — $35

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(E) TEN-TEC KR2-A Single Paddle — $17

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Be Mr. Clean!

—simple RTTY trash remover

Like most ham projects, my entry into RTTY was neither planned nor anticipated. One day I was given the opportunity to acquire, at a very reasonable price, a Model 15 machine, a converter (TU), and a loop supply. I hooked it all up, after spending a few frantic hours chasing through the 15 trying to trace the circuit along grease-coated wiring whose insulation is black. (Try that sometime and you'll appreciate the effort, especially when you realize that most of the interior of my machine is painted black!)

Don't Put This Thing on the Air

Finally, I got the thing typing on the local loop, but I had second thoughts about going on the air with it after I examined the output from the ancient keyboard. Looking at the output from the keyboard contacts with a triggered dc scope, I saw that the usual mark and space signals were sometimes accompanied by some very short (several milliseconds wide) space "glitch" signals (see Fig. 1). These are due to the keyboard contacts opening when they are not supposed to and can be eliminated by careful transmit contact adjustment. They may appear between consecutive mark bits when you have a character code that consists of two or more consecutive mark bits, such as in the letter M (A in Fig. 1). Or they can appear during a mark bit if one transmit cam has a low spot that allows the contacts to open momentarily (B in Fig. 1). To all mechanical printers and to those electronic systems that use mid-bit sampling, this extra narrow space bit poses little or no problem. However, transmitting such a trashy signal would mark you as a definite klutz, and besides, it requires more bandwidth to transmit that dirty signal than it does to transmit the correct code. On the older machines, the contact adjustment mentioned will not hold for any appreciable time, so I deemed it not feasible to adjust, but better to eliminate.

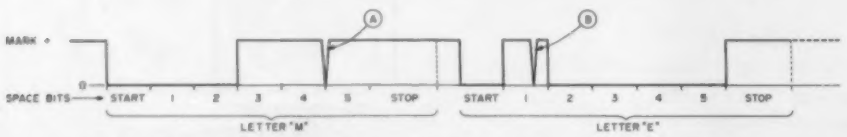


Fig. 1. The Baudot letter "M" has a narrow dropout (A) between bits 4 and 5. The letter "E" has a dropout (B) during the bit period. The dropouts are quite common in worn or misadjusted keyboards.

The Solution

The quick and easy solution that I used to clean up the serial Baudot from the keyboard is shown in Fig. 2. The heart of the circuit is the National LM3302 quad comparator, only one section of which is used. Other comparators can be used with appropriate pin changes. Parts are not critical, nor is layout. I used a PC board because it was convenient to do so, but perfboard construction would do an admirable job.

Circuit Operation

Isolation from the high-voltage loop is afforded by the optical coupler; mark current will cause a 12 V high at pin 4 of the optical coupler. The resistor-capacitor combination connected to pin 7 of the comparator acts as a low-pass filter that turns the narrow dropout space into a rather shallow dip in the overall mark amplitude. Resistors R1 and R2, connected to pin 6 of the comparator, set the comparator reference level, which should be chosen to be below the lowest point of the dip. I have mine set at 6 V. As long as the voltage at pin 7 stays above the comparator reference level, the output from the comparator at pin 1 will remain high. During the normal mark-to-space transition, the voltage at pin 7 drops well below the comparator reference level, and the comparator output

switches low. Therefore, the output from the comparator looks just like what the input from the keyboard should look like, the dropouts having been neatly removed.

It may be necessary to juggle the values of the resistor and capacitor in the low-pass filter to accommodate various widths of dropouts. An alternative would be to change the comparator reference level by altering the values of resistors R1 and R2. The formula for finding a particular reference level is:

Vref = Vcc x R2/(R1+R2).

Resistors R1 and R2 can be any value, but keep the total of R1 + R2 at least 10k to minimize the current.

Output Sense Selection

By interchanging the two input pins to the comparator, you can invert the output waveform. In the configuration shown, the output at pin 1 will be the same as the input. By interchanging pins 6 and 7, the output then becomes the complement of the input. This may be necessary depending upon the circuits that are connected after this circuit. Either way will work equally well. One small note of caution is in order: The LM3302 has the uncommitted collector of a rather "spongy" NPN transistor internally connected to pin 1, so keep the current into pin 1 less than about 4 mA. Much more than this will give you problems, especially at the higher baud rates.

Supply Voltage

Supply voltage for the comparator is not critical, and the whole thing draws less than 10 mA. Use a well regulated supply, especially if you are following this circuit with an FSK circuit. The chip that I used will operate with a Vcc of 5 V to 28 V. I chose 12 V dc because that voltage was already available from a CMOS source elsewhere in my RTTY system. Values shown on the schematic are for Vcc of 12 V dc.

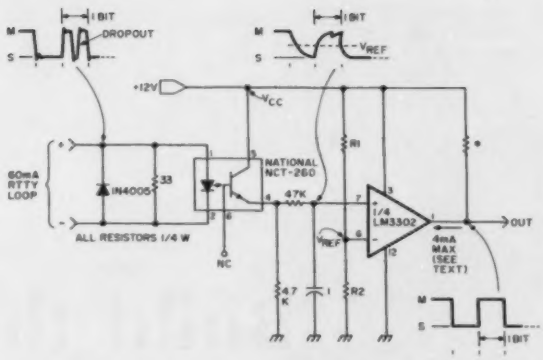
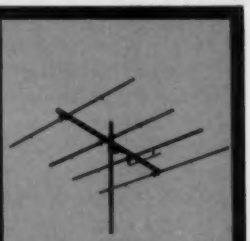


*Fig. 2. Trash remover neatly strips unwanted dropouts from the RTTY signal. *Choose the value that, when in combination with the circuit that follows, will limit current into pin 1 to 4 mA (see text).*

Physical Location

The completed circuit can be located almost anywhere. I installed mine on the loop-supply chassis because I am using the other sections of the quad comparator for other things. You could mount the whole thing inside the machine. There is room for a power supply back behind the mechanism on the Model 15 typing unit. Remember the oil problem, however, and use good components if you mount it in the machine. Petroleum-based lubricants can raise havoc with insulation and other materials that are not classified as "oil-proof." ■

30 YEARS...



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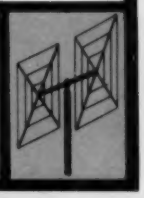

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Build the Triple Threat Keyer

—great Novice project

The new versatile electronic keyers now available, particularly the second-generation "memory" types, offer considerable flexibility of operation over the straight key or telegrapher's bug in serious CW work, whether it be contesting, field day portable operation, or high-speed traffic handling. It is generally agreed that the first-generation keyers such as those offered by Heath, MFJ, Ten-Tec, Palomar Engineers, and others, as well as those home brew units described in the amateur literature over the past several years, are generally excellent units, some featuring built-in paddles and others requiring the use of an external paddle mechanism. The newer units, such as the recently-introduced "CW Sendin' Machine," the Daytronics Contester, and the Autek Research MK-1, are definitely way out in front as truly state-of-the-art devices. They will probably rapidly replace the former as costs come down with mass production and simplified circuitry.

Most of these newer keyers and many of the simpler types require external paddle mechanisms. For portable and field day use, the station's expensive delicate paddle mechanism is something you'd rather not take along, when the unit may be dropped, scratched, or otherwise mishandled. To reduce the risk of damage, I have designed and built a simple three-in-one unit that combines a paddle, sideswiper key, and straight key in one box, along with a simple CW clipper/filter thrown in on the side. The little unit, fulfilling the need for a small, dependable, and lightweight (not to mention rugged and inexpensive) keying mechanism, is little more than two carefully adjusted lever-action switches — one SPDT switch arranged so as to function as either a keyer paddle or sideswiper key* (QCWA types may remember those) at the flick of a switch, and the other wired as an SPST device to act as a simple straight key. Added as a convenience feature is a miniature momentary-contact SPST push-button switch across the straight-key contacts for use in tune-up. This design is simple in operating principle and is far superior to push-buttons as the dash and dot contacts in small portable keyers; the latter are frequently unreliable and difficult to use properly, not to mention being uncomfortable after any extended period of use.

The Blitz-Box, as this little gadget has been dubbed, is built into a small Radio Shack #270-251 enclosure and can be used in any of the three ways described. For quick trips, you might consider leaving the regular keyer home entirely and bringing along the little box for use as a sideswiper.

Practically any of the Switchcraft "Lev-R" line of switches can be used. These cost from $3-4, depending on the number of sections and contacts. This series of switches has the advantage of being narrow and not too large, requiring only a ½" mounting hole. Actually, any lever-action, spring-return switch could be used, as long as you can get one set of SPDT contacts for the paddle and a set of SPST contacts for the straight key. I used two identical multiple-section junk box switches obtained on the local surplus market for about 50¢ each. Just be sure that the switch selected has a center-off position and is spring loaded and that you have the right type of contact arrangement to give you the SPDT and SPST contacts (the ones I used had to be taken apart and some contacts reversed — a two-minute surgical operation). The additional unused contacts on the lever switches provide convenient mounting points for the various components. Conventional wiring techniques are used throughout. Don't omit the bypass capacitors, as they offer some degree of key click and contact sparking protection.

*David H. Atkins W6VX, "QLF? Not with the Great Lakes Sideswiper!", *73 Magazine*, March, 1977.

As can be seen from Fig. 1, the keyer switch is wired so that, by moving the lever in one direction or the other, a dot or dash closure is obtained. Keying feel on both paddle and straight key is easily adjusted to suit individual taste by judicious spacing of the switch leaf contacts to control travel, using a pair of long-noise pliers. In making these adjustments, take care to strike a balance between feel, operating comfort, and reliable contact closure. Also, if the cabinet slides around on the operating table while pounding brass, epoxy a couple of small lead fishing weights inside the cabinet or place a piece of double-backed tape under each mounting foot.

The photo shows that the original plastic knobs have been left on the lever switches, no real paddle, as such, being installed at all. A paddle can be made from a piece of Plexiglas™, Bakelite™, or fiberglass PC board material and painted black. File down the original switch knobs, or remove them. Surprisingly, I have found that the rather large knobs which came with the switches provide a satisfactory feel and do not cause excessive finger fatigue or glass arming. Try building the unit without the paddle extensions, and install them only if necessary, cutting and filing them to slide over the original plastic knobs and epoxying them into place.

As a matter of convenience, particularly for portable and field day use, a simple audio clipper/filter is installed in the same enclosure to cut high-frequency response and to control the volume of received signals to prevent blasting, particularly in weak-signal CW work where agc may be disabled (a real ear-saving device). The clipper simply chops off the audio above a certain threshold (determined by the operator and the diodes installed), reducing the potential for blasting and at the same time clipping strong noise peaks. The filter, which consists simply of a couple of selected capacitors, is not intended to substitute for good receiver i-f selectivity, a must for serious CW work; it is intended to be used in conjunction with a receiver that has at least a fair degree of selectivity of its own, serving mainly to roll off high-frequency audio response to reduce annoying static crashes, adjacent channel splatter, receiver audio hiss, and noise.

As far as the filter shown in Fig. 2 goes, the two silicon diodes are simply connected back to back across the headphone line, and, with a threshold conduction point of about .6 volts or so, prevent the amplitude at the headphones from rising further. Signals below the threshold of conduction are not significantly affected by the action of the diodes. R1 and R2 are selected to enhance the clipping action and do slightly cut headphone volume. However, most receivers have adequate gain to allow for the loss caused by the clipper and the roll-off filter capacitors. R1 is not critical but should be around 47 Ohms, while R2 should be several times the headphone impedance. I used a 100-Ohm pot to allow adjustment of the headphone level when the clipping point is reached. Adjustment of this pot, and the receiver's regular audio gain control, is best determined by trial, and should be a compromise between desired clipping action and headphone volume level. Usually, it will be found that the best clipping condition is that which just starts to take hold on fairly strong signals, leaving the weak ones and the noise background untouched. I have found that it is generally best to run with the audio gain well advanced and to adjust clipping level by riding the rf gain control. Note, too, that the clipper makes it a bit more convenient to run with agc off and to work break-in, since there is no thumping or gain recovery time, distinct advantages when trying to work full break-in.

The desired filter characteristic is enhanced by C4 (medium/wide bandpass) or by paralleling C4 with C5 by use of SW4 in the narrow position. I have found that, with the capacitor values shown in Fig. 2, the medium/wide position works quite nicely on SSB (and on CW when interference isn't too great), while the narrow position, with its roll-off probably less than 1000 cycles or so, is helpful in crowded-band CW work. Although only two capacitors are used in my circuit, a fancier arrangement might use a single-pole, five-position switch to cut in four different values of capacitors (say, .1, .22, 1, and 2.2 uF), with the fifth position being not connected and used to cut out the filter entirely. Larger values of capacitance should not be used, as the filter will tend to simply short out the receiver audio. The capacitor values are best determined by trial.

Assuming the filter is used with a receiver with decent i-f selectivity (or even one of the newer SSB transceivers without the optional CW filter installed), its simplicity becomes its own advantage in that excessive audio selectivity can become extremely monotonous and fatiguing over long periods of operation. It is then not practical to vary the tone much while operating, and you're stuck with the beat-note tone you've tuned up the filter for. Use of the simple untuned filter described has been found to be entirely adequate with a Tempo 2020 (which has a 600-cycle CW filter) and with several receivers primarily designed for SSB work. In either the wide or narrow positions, it cuts out a great deal of background noise, improving signal-to-noise ratio and noticeably reducing operating fatigue. You get all these features at a total construction cost of less than $10 for the whole unit.

Though the designs incorporated in the little 3¼" x 2-3/16" x 4" unit are by no means novel or unique, taken together as a package they afford a great deal of flexibility to portable operation with various transceivers, receivers, transmitters, and keyers. ■

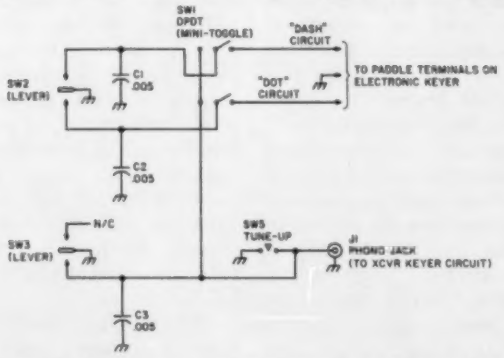

Fig. 1. Keying portion. All component values nominal.

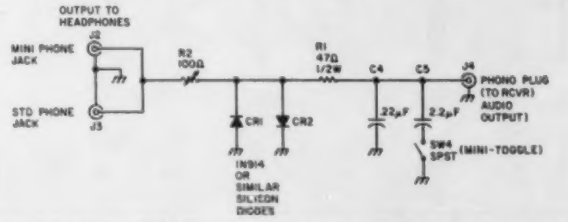

Fig. 2. Clipper/filter portion. All component values nominal.

The Ten Meter AM Antenna Special

—$5 vertical also works on SSB or FM

Alan Kaul W6RCL
9731 Nevada Ave.
Chatsworth CA 91311

Ten meters is a funny, band—not funny, ha-ha, but funny, peculiar. Sometimes it "opens" to what sounds like everywhere. Sometimes it isn't "open" at all. And, occasionally when it is open, it is open only in one direction. To take advantage of the band's peculiarities of propagation, you need an antenna which will give you a low angle of radiation and an omnidirectional pattern. If you have a beam sitting on top of a 70-foot tower, that's terrific, because the parasitic elements and the height above ground give you the radiation pattern you want and the antenna rotor provides the 360 degrees of versatility.

But if you don't have any of that, consider this: a rooftop ground plane which is wind resistant and can be built from scratch with new parts for less than $5. The vertical polarization gives you the low angle of radiation needed for long skip, but it won't cause cross-polarization problems when working DX because the signal tends to get unpolarized when it bounces off the F-layer. The vertical polarity will also help with local QSOs when working from your base to someone else's mobile (most, if not all, 10 meter mobile rigs are used with vertical antennas). If you're not able to work 10 meters because of equipment problems, this antenna might help make up your mind if you've been thinking about converting a CB radio to 10 (73 has published several CB to 10 conversion articles since the first one appeared in May, 1977).

The construction of this antenna is simple. The only tools you'll need are a

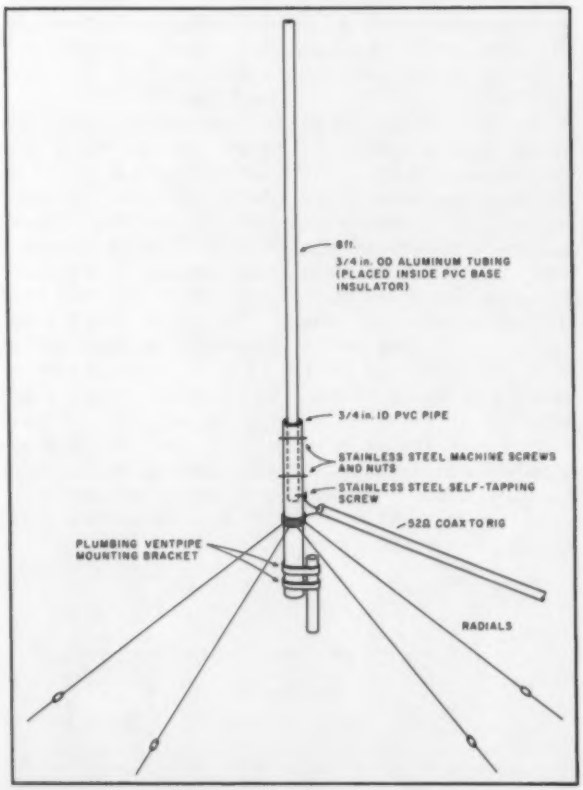
8ft.
3/4 in. OD ALUMINUM TUBING (PLACED INSIDE PVC BASE INSULATOR)
3/4 in. ID PVC PIPE
STAINLESS STEEL MACHINE SCREWS AND NUTS
STAINLESS STEEL SELF-TAPPING SCREW
52Ω COAX TO RIG
PLUMBING VENTPIPE MOUNTING BRACKET
RADIALS

Fig. 1. Design of the $5 vertical.

hacksaw, screwdriver, soldering iron, and wire cutters. Installation is simple, too. This antenna uses a commercially-available mounting bracket (I'm using a plumbing ventpipe mount which I bought for my TV antenna at a hardware store for less than $2, but a chimney mount or eave mount would work equally well). The antenna will handle several hundred Watts PEP, and, if constructed to the proper dimensions, you can expect a standing wave ratio of less than 1.5 to 1 (mine is below 1.5:1, between 28.5 and 29.0 MHz). While this particular antenna is designed for 10 meters, the same basic pattern can be used on 15 meters using the same size diameter tubing. If you want to design a similar antenna for 20 or 40 meters, I'd recommend doubling or tripling the diameter of the tubing for strength and placing nylon guy ropes near the top of the completed antenna for stability.

Everything you need for 10 meters is shown in the parts list.

Construction is straightforward. The aluminum radiator slips inside the PVC tubing and is held in place with the two stainless steel screws. The self-tapping screw goes through the PVC insulator into the aluminum near its bottom end, and the coax center conductor attaches to the self-tapping screw. The radials are soldered together at one end and affixed to the PVC base tubing with the hose clamp. The coax ground braid is soldered to one of the radials. If you want to get the antenna aluminum tubing more than a foot or two above the roof, the radials should be tied down firmly as guys. If you want to put the antenna even higher—8 to 10 feet above the roof—I'd recommend you invest in an inexpensive television antenna mast of the same inside diameter as the outside diameter of the PVC. Slide the PVC inside the mast and fasten it using two more stainless steel screws.

The angle at which the radials meet the base insulator will have an effect on swr. If the radials drop vertically from the radiator, the antenna essentially would be a vertical dipole and a good match would be obtained with 72-Ohm coax. An angle of 40 to 50 degrees should be a good match for 52-Ohm coax. As the angle approaches 90 degrees, the impedance of the antenna decreases and the mismatch is reflected in an increasing swr.

That's all there is to it. The rest is in Fig. 1. Oh, yes, one more thing—the last time I wrote an article for 73, I received 35 inquiries by mail requesting more information. I'll be happy to answer all letters, but only if you send a self-addressed stamped envelope.

See you on 10. ■

Parts List

one piece of aluminum tubing (8' × ¾" outside diameter)
one piece of PVC pipe (any length × ¾" inside diameter—double-wall is recommended for strength)
two stainless steel screws with nuts and washers (8 x 32/1½" works fine)
one self-tapping sheet metal screw
one automotive-type hose clamp (1½" inside diameter)
four 8'8" lengths of copper wire for radials (copperweld or similar if vertical element is sufficiently above the roof requiring the radials to double as guy wires)
four strain insulators
one piece 52-Ohm coax, any length to transmitter
one installation bracket, your choice

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W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 8

up a lab with the latest in microcomputers up and running so submitted programs could be tested for accuracy and interest. Next, I encouraged programmers to get cracking. The first of these programs to be published were introduced at the National Computer Conference in early June and the response was immediate—just what everyone needs.

Our facilities for duplication are limited. We have about 50 top-notch cassette recorders set up in parallel for copying. We've been using these for our code and Novice theory cassettes. With these, we can crank out perhaps 500 per day, if everything runs smoothly. That's pitiful when we look at the demand for program cassettes.

We're gearing up to turn out four new programs a day... that's 20 per week. With about 1,000 computer stores already up and running and another thousand being planned for the near future, we would need to turn out a bunch of cassettes just to keep new programs going to the stores. Say we shipped them ten of each new program... that means we would be shipping 40,000 cassettes per day, not including any repeat orders. Obviously this means high speed duplicators, a rather large new plant, another computer to keep track of the business, packing and shipping machinery, a bigger computer lab, more editors to check out programs and prepare master tapes, etc.

There are more millions to be made in microcomputing in making accessories for the popular systems. I'll be surprised if there aren't more millionaires in the next few years than ever before in the history of the country. Interested parties can contact me for my consulting fees. Ahem.

In view of my grandiose software plans, you can perhaps understand why my reaction to the lack of a letter to ask for funds for an African mission was mixed. I'm reminded of the old joke about the mixed emotions of the chap watching his mother-in-law go over a cliff in his new Cadillac.

After being on the poor side for most of my life, the prospect of money is fun to contemplate and, like the loss of frequencies, I don't actually believe it. If it really happens, I'll try to believe it. In the meantime, whether I believe it or not, we have to get going on the new plant, getting tapes out, etc. This means hiring a lot more people—anyone interested with some of the backgrounds we'll be needing in management, cassettes, programming, financial planning, production, packaging and shipping, automated machinery, etc.?

EUROPE '78

Sherry and I arrived in London in late May to find my favorite hotel full. We had to settle for rabbit-warren-type accommodations. Most surprising of all was the prices—about double those at home for most things. Would you believe $4.50 for a simple roll and coffee "continental" breakfast? After two days of this, plus a meeting with a microcomputer manufacturer and a visit to a microcomputer store, we went to Paris. The prices were not lower.

The main event in Paris was Micro-Expo, a microcomputer show. It was mobbed and we sold a bunch of subscriptions to *Kilobaud*. One of the high points of this show for me was my talk to the assembled multitudes... the room was packed, with the audience spilling over into the aisles, on the stage, and backed up out in the halls. There's enough showman in me to enjoy an enthusiastic crowd liked that, and to know that word of *Kilobaud* had spread even to Paris and the continent.

I spoke on the microcomputer $300 million fraud, the selling of microcomputers without the programs to back them up. I emphasized the need for the developing of software for microcomputers along with the hardware, if we are not to suffer a devastating disillusionment by the general public. I offered some proposed solutions to the dilemma. The response was very good.

From Paris, after checking out the Louvre carefully and trying some meals in Moroccan, Greek, and Vietnamese restaurants, we went on to Zurich, switching from French food to fondues. We rented a car and drove through Berne to Geneva and talked almost a full day with the amateurs on the permanent staff there, and with the chaps at 4U1ITU. The ham station there has seen better days and possibly is reflecting the low morale of the hams who see the coming ITU meeting as no reason for joy.

In addition to a vintage Yaesu FT-101 station, there was a wonderful old Collins rig. They also had one of the ARRL low-powered CW stations which have been developed for use in third world countries. This is on display for any representatives from these countries who might visit the ITU.

The truly unfortunate aspect of this rig is that the whole concept involved is abhorrent to most of the emerging nations. The ARRL meant well when it developed and backed this idea, trying to make it possible for a real low-cost personal ham rig to be made available for hams with next to zero budgets. The idea is fine, as long as you have never visited these countries and are ignorant of their situations.

The fact is that there are few of the emerging nations where the rulers are interested in citizens having personal communications. Most of these countries are shaky and the rulers are quite interested in staying in power. They know that if individuals are able to develop communications, the same thing could happen to them that the British set up when they permitted all those ZC6 hams to operate... and they quickly became the communications network which helped Israel to get started. It is doubtful if Israel would have made it without the hams.

Remember that King Hus-

W2NSD/1's address at the Paris micro show was made to a packed house.

At the Paris Exposition of Microcomputing, Monika and Reinhard Nedela, the European Kilobaud *representatives, did a brisk business at the* KB *booth.*

sein set up ham communications even though his country was involved in a civil war. This never would have been permitted on an individual basis... too much chance for enemies to use the radios for fighting against the government. But the setting up of club stations for the youths gave enough control of the situation so there was no worry. The same holds true for most small nations—club stations are okay, personal communications, no way. Put it this way... how many personal stations have you contacted in Russia? The chances are that, with very few exceptions, you've worked only club stations.

After talking with the hams at the ITU and making an hour tape of some of the more important aspects of the interviews to be played to ARMA at Atlanta, we drove off to Luzern, one of the most beautiful of Swiss cities. The next day we drove on to Liechtenstein for lunch, a quick drive through Austria and Germany to make it four countries in one day, then back to Zurich.

The next day we flew back to the U.S. and, after one day at home, grabbed our suitcases and were off to Atlanta for the ARMA meeting and the Atlanta Hamfest-Computerfest.

I've covered the ARMA meeting pretty well. The hamfest was excellent, as usual. I had a good audience for my talks on computer software and the state of microcomputers today, and for my talk on WARC and the African situation. I would appreciate getting a tape of the ARRL forum on Sunday, for I understand that, while most of the meeting was devoted to a critique of *QST* covers, just at the end Eaton got up and said that the manufacturers were going to send a trade mission to Africa to try and develop a market for ham gear there. I think the innuendo was that this would then stop the Africans from building equipment just as the industry has stopped building here. This is an old anti-manufacturer line from the ARRL and is a crock. Hams are building more than ever before in history; you have but to look at the dozens of pages of parts ads in *73* to know what the real story is, and then compare that with the parts advertising from any period in the past.

It sure looks to me as if *QST* is afraid to let the manufacturers get together and form an organization and will do what they can to torpedo the effort. The manufacturers made *QST* eat crow on their demand that ham gear only be sold to hams, and more crow is on the menu after the recent *QST* proclamation that manufacturers would have to submit equipment for *QST* evaluation for purity of signals before ads can be run in *QST*. If *QST* would *ask*, the industry would probably bend over backwards, but no one likes to be commanded.

From Atlanta, we headed for Anaheim and the National Computer Conference (NCC). Some 40,000 people gathered to see the latest in computers and systems, with a separate exhibit area for microcomputers. Our booth was there, in the Disneyland Hotel. We were there four days and never had one hour to spare to go next door and see Disneyland!

The main exhibit for us was our new software packages. We're getting geared up to turn out about four new computer programs a day. These are written by *Kilobaud* readers and we are just publishing them and putting them on cassettes for users. The response to our software was fantastic; every manufacturer was enthusiastic and my talk at NCC on the subject was well received.

While in town, I had dinner with Pete Hoover K6ZH and discussed the WARC situation with him. Though the ARRL has been trying to cover it up, many influential hams have been pressuring it to *do* something about the African bloc situation. The heads of the ARRL Foundation tried to organize a fund drive to help with this, but Baldwin cut it off and the officers of the Foundation resigned in protest, including Pete. Pete is the son of Herbert Hoover, Jr., past president of the ARRL, by the way.

One of the large publishing firms also took us to dinner, wanting to buy out the magazines. That's ego-gratifying to hear, even though I can't think of any reason to sell. With our computer software plans about to dwarf the magazines in sales, this is not a good time to think about selling, even if I was of that mind. I enjoy publishing too much to change.

From Anaheim, we made a quick trip to San Francisco to visit Lomac and talk with John Peers, a most enthusiastic and intelligent chap. We sat down and found his Adam computer a delight to program, so much easier than anything else we've tried—a dream. From there we checked out some high speed cassette duplicating equipment—should cost about $200,000 for what we need—and then off to dinner with Bill Godbout, George Morrow, and Bob Mullen. What a fantastic trio!

When Godbout throws a dinner for friends, he does it first class... complete with a flight in his plane for a half hour or so, then a long taxi ride to Mark West for dinner. All three of them are so full of ideas that even a few minutes with them is exhilirating. One of the delights of both the ham and computer business is that talking business is fun. We talked over new product ideas, advertising approaches, possible ways for the market to go, the impact of various new systems, and before we knew it, the restaurant was closing and we had to come back to the real world.

The next morning, Sherry and I headed for Los Angeles, then on to Atlanta for a short appointment there, staying for the first time at the Omni. You can

The BirmingHamfest was indoors this year in mid-May and brought a nice turnout. About half of the displays were in the flea market area, seen here.

Though a good part of the trade exhibit area was occupied with ham stores, there were a few manufacturers such as Ten-Tec, Kenwood, etc., seen here.

bet I'll be getting to the Atlanta Omni as often as I can. It's no wonder that Underground Atlanta has been hurting. They have the same type of entertainment in the Omni, but without the junk. We're both Frogurt fans and, sure enough, the Omni had a Frogurt stand . . . and several restaurants . . . and a fudge store (why does one pound of fudge help me put on five pounds of weight?) . . . love their orange fudge . . . a McDonald's (I like their breakfasts) . . . etc.

The next morning we were off again to Puerto Rico. We only had a couple hours between planes, so we caught a taxi to town and went to El Morro, the fort commanding the entrance to the harbor. Then we flew down to Martinique for three days of rest and recuperation. Again we were on an Eastern special fare tour which costs less than the round trip to California. The islands are packed all summer as a result of this new Eastern fare . . . what a great idea that turned out to be . . . and the Eastern planes are packed, too.

Martinique is beautiful, but there must be a rule against the natives smiling. Everywhere we went, the natives were dour. In the restaurants, they did their job but cast gloom everywhere they went. The prices in Martinique, like St. Martin and Paris, were horrendous. Four dollars for a breakfast with two cups of coffee and a couple rolls, a pat of butter, and a dab of jam. It sure makes McDonald's look good. At least in Paris, you *could* go to McDonald's . . . two of them on the Champs-Elysees.

As usual, I had ordered a Budget rental car to be waiting for me. I had a bit of a hassle getting the car, and then when I started to drive off, I found it was almost out of gas! Ugh. We had about two francs of French money, so I had to pay for gas with American money, it being Sunday night and there being no banks open. The gas station ripped me off for half the regular exchange rate, bless 'em.

The hotel was about 20 miles from the airport and the route signs were minimal, so I drove through the blackest night I've seen in a long time, nursing a very crummy Fiat car along. The light switch panel was hanging out of the dashboard by its wires, and the rest of the car was not in much better shape. Just as we got to one of the darkest places, a tire let loose. I was still dressed in nice clothes, the temperature was around 85°, and I had not the slightest idea where to find the spare tire, the jack, or the tools.

Luckily, I had a flashlight with me. Am I glad I carry that! It's part of my kit . . . camera, spare lens, film, cassette recorder, battery, and a couple games to play on planes, such as Boggle and Cribbage. Also the flashlight. I found the tool kit, but the jack was a bit more difficult to locate . . . finally found it up under the front hood, along with the spare tire. The spare looked as if it would give out shortly, too.

Much to my amazement, a native stopped his car and offered to help. I was organized by this time, but he did help out and gave confidence. We got the tire changed in short order and I continued on to the hotel.

The next morning, I discovered a Budget office right across from the hotel, so I went on over and asked them to fix the tire. No, I'd have to take the car back to the airport where I rented it. I looked at the spare, which never would have made it that far, and got up a head of steam. I got out my camera and took a picture of the spare tire, the car, and then tried to take a picture of the gal who was giving me the hard time. This changed things. She wanted to know what the pictures were for and I announced that I was a journalist and knew when I had the makings of a story. She quickly pointed to another nearby car and said I could exchange my jalopy for that one, even though it should rent for more. It was a slightly better Fiat, so I said okay. I hate having to rattle my magazine at people, but dammit, I sure don't like being victimized.

Something similar happened the next day. Eastern had included a prepaid tour of Martinique in our fare. I checked with the hotel and asked about it. They pointed across the street to a tour office. I went there and asked about the tour, showing them my coupons. They set it up for the next morning.

Sherry and I arrived for the tour on time, got into the taxi provided, and we set off. The driver went about a quarter mile and stopped, asking what we wanted to see. I said we were supposed to get a tour of Martinique and he said, oh no, that those tours left only from the capital, Fort de France, and that we should have taken the ferry across the bay and met him there. Oh, he could drive us up to Fort de France, but that would be $14 extra. Beginning to suspect foul play, I asked to be returned to the tour office.

At the office, I went back over the scenario and asked why I had suddenly been presented with a bill for $14 for a tour which was supposedly prepaid. They suddenly had trouble speaking English . . . perhaps something could be arranged for tomorrow from Fort de France, they suggested? I said no, we're going to Dallas tomorrow. I said that this had all the appearance of taking advantage of tourists and, as a journalist, I found this most fascinating. They then decided that the taxi would take us on the tour of the island without our paying the $14. I'd lost a lot of interest in the deal, but eventually they wheedled me into going. I'm glad I did, for it was a fantastic drive, even though the driver sulked the whole time.

If you have a chance to get to Martinique, I would recommend that you be sure to take this drive up through the rain forest and back down the coast, stopping off at St. Pierre, which used to be the capital of the island. We did see one interesting thing during the trip in addition to the fantastic beauty, and that was an old jalopy stopped at a bend in the road where a pipe came out of the side of a hill. Two people were there filling some plastic bottles with water. We could see the blue and orange labels on the bottles and I said I'd bet that they were going to sell the water.

That evening, back at the hotel, Sherry ordered her usual Perrier water . . . all out, but we have some good local mineral water. They brought out one of the same bottles we'd seen being filled. It tasted exactly like water. Quite a business at $1 a bottle.

There were three restaurants right next to our hotel, the Del La Marina, one Chinese and two French. On the mineral water episode evening, we picked the Brasserie Restaurant and presented ourselves for dinner. The woman seating people ignored us for a while and then pointed across the room at an empty table and went on about other business. After fifteen minutes, a waitress stopped and asked what we wanted to drink. This resulted in the Martinique water bottle. A half hour later, we still had had no further attention, not even any bread. We gave up and left, going next door to another restaurant where we were served promptly, if unsmilingly. What a bunch of unhappy people!

The hotel room was spartan, but comfortable, and had a kitchenette, complete with refrigerator. And right next door was a small grocery store, so we enjoyed bananas, coconuts, ripe pineapples, cheese, and lots of Perrier water.

Since we only had a three-day visit sandwiched in between shows, I didn't take a rig along. Licenses are not difficult to get there and I think the next trip will see a rig under one arm.

DALLAS

Eastern picked us up on schedule, stopped by St. Martin for a few more passengers, and then took us to San Juan for a plane change. We had to go through a customs inspection here and that was frustrating. We had two hours between planes and we spent one solid hour on line at customs, watching a woman go through every square inch of every piece of luggage of every person on the line. It seemed to take forever.

Since we had bought absolutely nothing, not even a postcard, she was a little speedier in going through our six pieces of luggage. Martinique prices are not much different from Paris prices, an effective economy measure for us. I needed shoes badly, but at $75 a pair for $25 shoes? Phooey.

The Eastern route from San Juan to Dallas went to Miami, Atlanta, and then Dallas. Naturally, the plane broke in Miami and our flight would be delayed an hour. We had a one-hour wait at Atlanta scheduled, so this meant we would lose that connection. A little look at the flight schedule showed a plane leaving later going direct to Dallas from Miami, arriving a few minutes after our originally scheduled flight. We changed . . . and hoped for the best on the luggage.

The best was not to be.

An hour after we arrived in Dallas, a plane came in bringing two of my three bags. The third bag was located a couple days later, having detoured to Chicago for some obscure reason. Naturally this was the bag with my clothes, so I had to rush out and buy a new suit to use at the show. I was scheduled for two performances, one on computer software and the other on WARC.

We'd shipped a couple of suitcases and four boxes of stuff from Los Angeles to Dallas, hoping to pass up taking all that to Martinique. The suitcases were waiting for us (with subscription blanks), but no boxes. Eventually, we did find three of the four boxes . . . they'd been shipped to Atlanta . . . and got them back in time for the show. Between the boxes and the missing suitcase, we spent many hours and bucks on phone calls.

RENTAL CAR RIPOFF?

Budget pulled a stunt on me at Atlanta that bugged me. I've been using 'em for years and

Continued on page 162

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Buddy, Ya Got A Match?

—build one L of a matcher

William Vissers K4KI
1245 S. Orlando Ave.
Cocoa Beach FL 32931

Although the L-network is theoretically capable of matching any two impedances, many amateurs have encountered problems in its use. The difficulties are often twofold. The first is a failure to fully appreciate exactly how the network wants to work for various load conditions. And, secondly, the size of the variable capacitor required often reaches values that are generally unobtainable. However, both of these problems are very easily overcome. The first can be surmounted by a fundamental review of matching principles. And the second obstacle can be readily overcome by a simple design change that allows a small variable capacitor to be used where formerly a large one would have been required.

An experimental breadboard unit has been successfully used here at K4KI. It was economical and simple to build and also is easy to use. The basic L-unit, a simple switching circuit, and a small fixed inductance allow full matching capability to be readily realized on all bands from 10 through 80 meters.

Mathematics

Unfortunately, I'm going to have to keep the mathematics really simple because of something that happened to me many years ago at the little two-room school where I started my education. One day, the teacher asked me, "Willie, if I take three apples from eight apples, how many apples do I have?" Well, naturally, I told her that, if she took three apples, she'd have three apples. The expression on her face somehow indicated that this wasn't the answer she expected. So she started to explain that when she said she took three apples, she really didn't have three apples, but, just as we were getting into it, the recess bell rang. Well, when we got back to our math class the next day, our teacher must have forgotten all about it, as she didn't ask me again, and that's why I never did get into higher math. But the lack of it has actually been a blessing, because it really helps you understand things by keeping them simple. And you'll be surprised how simple the understanding of the L matching unit really is.

The Basic L-Unit

The easiest way to understand the basic L-unit will be by the calculation of an actual numerical example, combined with a set of tables that show network values and configurations for a range of loads representative of various antenna impedances. I'll start by calculating network values required to match a pure resistive load to the transmitter. And then later, I'll make the load a combination of resistance and reactance. Finally, I'll show how, with the addition of a small fixed inductance, you can reduce the size of the variable capacitor required.

As almost all transmitters nowadays have a fifty-Ohm output, I'll use that as a basic reference. For the numerical example, let's say the load is thirty Ohms of resistance. You can say that you are matching the high fifty-Ohm output resistance of the transmitter to a low resistance, which means you are matching from high to low. This concept is important, as the basic equations are given in terms of high and low. The transmitter, the L-network, and the 30-Ohm load are shown in Fig. 1. The network is made up of a series and a shunt arm. For matching a resistive output to a resistive load, one of the arms has to be inductive, while the other arm has to be capacitive. The equations used for calculating the reactance of the series and shunt arms when the load is a pure resistance are as follows:

$$X \text{ in Ohms of series arm} = \sqrt{(\text{low})(\text{high} - \text{low})}$$

$$X \text{ in Ohms of shunt arm} = (\text{high})\sqrt{(\text{low})/(\text{high} - \text{low})}$$

Substituting in the numerical values, we obtain:

$$X_{\text{series}} = \sqrt{(30)(50 - 30)} = \sqrt{600} = 24.5 \text{ Ohms}$$

$$X_{\text{shunt}} = (50)\sqrt{(30)/(50 - 30)} = 50\sqrt{1.5} = 61.2 \text{ Ohms.}$$

As you will, for purposes of illustration, want to add or

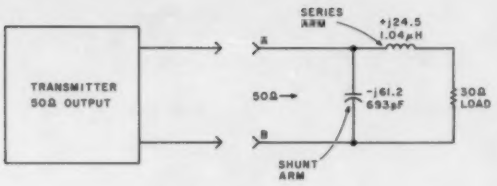

Fig. 1.

subtract reactances and also show whether a reactance is inductive or capacitive, you can use the standard notation that inductive reactance is +j and capacitive reactance is -j.

So Fig. 1 shows the inductive reactance as +j 24.5 Ohms and the capacitive reactance as -j 61.2 Ohms. With these values, you would find that the impedance looking in at terminals A and B is exactly 50 Ohms resistance.

There is, however, one other thing to do, and that is to translate the values of reactance into actual values of inductance and capacitance. In the two following equations, the term frequency will occur, so I chose the value of 3.75 MHz, the center of the 80 meter band, as the reference for all further work. Naturally, the values of inductance and capacitance can be calculated for any frequency desired.

$$C_{pF} = \frac{1{,}000{,}000}{(2\pi)(F_{MHz})(X_C)}$$

$$= \frac{1{,}000{,}000}{(2)(3.1416)(3.75)(61.2)}$$

$$= 693 \text{ picofarads}$$

$$L_{uH} = \frac{X_1}{(2\pi)(F_{MHz})}$$

$$= \frac{24.5}{(2)(3.1416)(3.75)}$$

$$= 1.04 \text{ microhenries}$$

At this point, it would be well to ask why the configuration of Fig. 1 was used in the L-network. It can best be understood by looking at Table 1(b) and again calculating the values of X_1 and X_C and then finding the actual values of L and C. The values of shunt and series reactance have the same numerical values as previously. However, if you calculate the values of L and C in Table 1(b), you find them to be L_{uH} = 2.6 microhenries, and C_{pF} = 1732 picofarads. The values are shown in Table 1(b), also. It is seen that the configuration of Table 1(a) is most desirable, as you require only 693 picofarads, as compared to 1732 picofarads, as in Table 1(b). It should be noted that either configuration will give a 50-Ohm match to the transmitter. Switch SW2 will allow either configuration to be selected as desired in the final circuit.

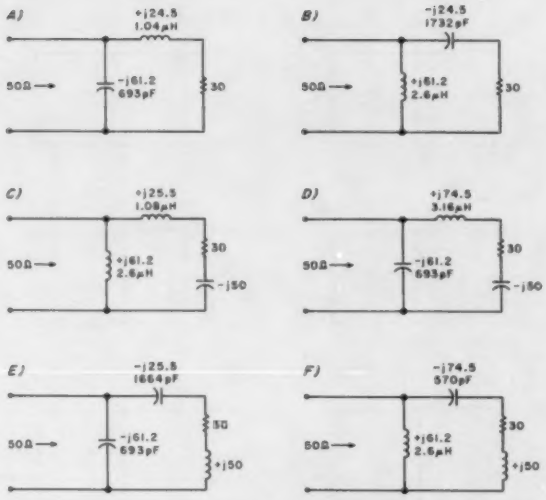

Table 1. Fifty Ohms to low-impedance loads.

Complex Impedance Loads

Now that the values of the network for a resistive load of 30 Ohms have been calculated, let's assume that the load has changed to the one shown in Fig. 2. Here, the resistance is still 30 Ohms, but there is also a capacitive reactance of -j 50 Ohms. If you look at Fig. 2, you see that the shunt capacity is still 693 picofarads. And you also see that the +j 24.5 Ohms is still used. These values just mentioned are basic in matching to the 30 Ohms of resistance. But, if somehow you could add an additional reactance of +j 50 Ohms in the series arm, it could be used to cancel out the -j 50 Ohms in the load. And you see that the total inductive reactance needed in the series arm is nothing more than (+j 24.5) + (+j 50), which equals +j 74.5 Ohms. This total inductance calculates out to be 3.16 microhenries. As these two inductances can be combined into one, the final network will be that shown in Table 1(d). So you see that the L-network can be used to match a complex impedance.

Now knowing the basics of calculating the values of the L-unit, it would be possible to further calculate the values of the series and shunt arms for quite a variety of loads. But let's not do this for several reasons. First, very few amateurs actually have rf bridges that let them know their exact values of resistance and reactance of their antenna. Secondly, as you already understand the basics of the calculations involved, and, as a picture is worth a thousand math symbols, it was believed that a set of tables showing values of reactances, capacity, and inductance for a range of loads generally encountered would be preferable to a lot of additional math. And, lastly, by seeing the actual values of inductance and capacity required, it will be easy to understand why the switches in the final circuit are needed to obtain the most desired configuration. The calculations used in making up the charts were based upon the basic equations for matching into a resistive load plus simple series-parallel equations when the loads shown are complex impedances.

Table 2 shows that you can also match the transmitter into a higher impedance than 50 Ohms. But, in that case, the series arm of the network is on the transmitting side rather than the load side of the circuit. This transformation is readily made by switch SW1 of the final circuit.

Canceling Capacitive Reactance

If you inspect the tables, you find that the value of capacitance needed using the most desirable configurations to match the range of loads is 693 picofarads. Well, this is sure a good-sized capacitor, and that kind is about as scarce as hen's teeth and twice as expensive. This value of capacitance is equivalent to a reactance of -j 61.2 Ohms, and you need this value of reactance to obtain a proper match. Is there any

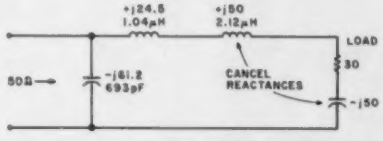

Fig. 2. The total inductance in the series arm is 1.04 uH + 2.12 uH = 3.16 uH. The total reactance in the series arm is +j 74.5 Ohms.

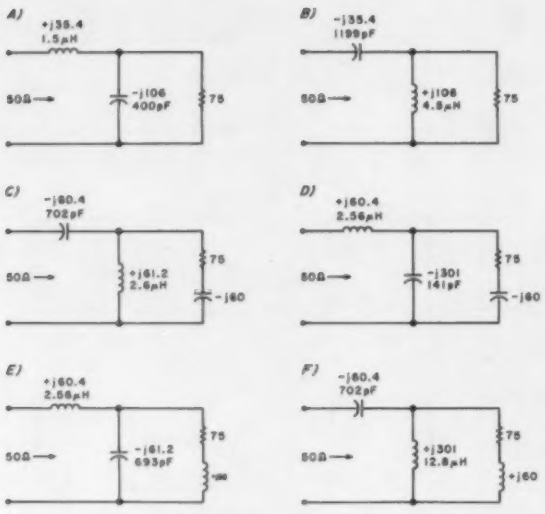

Table 2. Fifty Ohms to high-impedance loads.

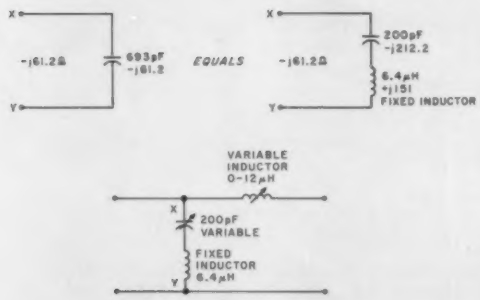

Fig. 3. L-matching unit.

other way to obtain a reactance of -j 61.2 Ohms without using such a large capacitor? Sure, and a bit of math no more difficult than subtraction will show you how to do it. Well, actually a bit of subtraction plus a small fixed inductance. And it's so easy that, at times, I feel a bit guilty at fooling the L-network that way, but it works and saves buying an expensive large capacitor where a small one will do the job.

Assume you only have a 200-picofarad variable available to use in the matching unit. Using the equation for reactance, you find that:

$$X_{200\ pF} = \frac{1{,}000{,}000}{(2)(3.1416)(3.75)(200)}$$

$$= -j\ 212.2\ \text{Ohms.}$$

Now, if you put an inductive reactance of +j 151 Ohms in series with the 200-picofarad capacitor with a reactance of -j 212.2, you will find the net result is -j 61.2 Ohms. This is the exact reactance needed for the series arm when a 693 pF capacitor is required. The value of fixed inductance is calculated as:

$$L_{fixed\ uH} = \frac{151}{(2)(3.1416)(3.75)}$$

$$= 6.4\ \text{microhenries.}$$

So a little bit of "magical math" shows that, by using a fixed inductance in series with the 200-picofarad capacitor, you make the circuit actually think that you have a 693-picofarad capacitor in the circuit. There is no longer the need to wistfully wish for a large expensive variable capacitor when a small readily available one will do the trick. The basic matching circuit described is shown in Fig. 3.

The Final Circuit

The completed circuit is shown in Fig. 4. As the amount of capacity required becomes less with an increase in frequency, it was found that the fixed inductance was not required on the 10, 15, and 20 meter bands and should be shorted out. As the amount of fixed inductance required is less on 40 meters than on 80 meters, a tap is used on the coil to reduce the inductance. All of these necessary switching functions are accomplished with switch SW3, a DPST with a capability of being left in the center position when the unit is used on 80m.

Switch SW1 reverses the input and output as required to match into a high or low impedance. Switch SW2 allows the inductive reactance and capacative reactance to be switched from series to shunt to effect a proper match, as needed.

Although the network was designed to provide maximum flexibility, my personal experience has been that, in many cases, the feedline can be adjusted for a 1:1 swr over an entire band without any switching at all being necessary. However, this depends upon the characteristics of the antenna being used. My design uses a 200-picofarad variable donated by K4YS, our president of the Indian River Amateur Radio Club, who was very much interested in the project. But, if a larger-sized capacitor is available, it can be used. In that case, you may want to make the fixed coil somewhat smaller. The 0-12 uH variable rotary inductor was picked up at a ham convention. Apparently, it came out of a piece of surplus equipment (probably a BC375 or 191 tuning unit).

There is no reason why a tapped coil with a rotary switch could not be used instead of the variable rotary inductor I used. The rotary inductor does have an advantage in that the exact reactance can be cranked in as desired. However, a properly designed tapped coil instead will allow you to get your swr down to a low level. In building the unit, the general precaution of keeping leads short

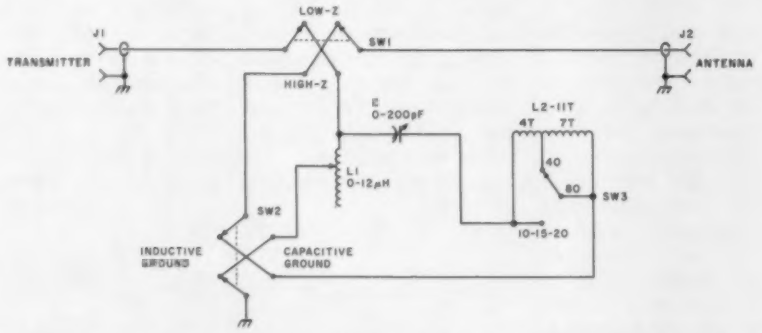

Fig. 4. Low-capacity L-type antenna matching network. L1 — 0-12 uH rotary inductor; L2 — 11 turns #12 enamel, space-wound 2-5/8-inch diameter, 1-3/4-inch long, tapped at the 4th turn, fixed inductor; C — 0-200 pF variable capacitor; SW1, SW2 — DPDT toggle switch; SW3 — DPST toggle switch with center-open position; J1, J2 — coaxial connector, chassis type.

is to be observed. But this is not difficult to do. By placing switch SW1 between the input and output coax connectors, the leads can be kept quite short. Proper placement of the other two switches will keep the remaining leads to a reasonable length. There were no current loops observed caused by stray capacity. A bit of experimenting with the size of the fixed coil may be desirable to insure the best tuning for the variable capacitor you use.

There are undoubtedly a number of purists who will throw up their hands in horror for whatever variety of reasons they may conjure up. It will be found that because the 200-picofarad capacitor actually thinks it's a 693-picofarad one, that the tuning may be a bit sharper, but that is no problem at all. It can be argued that the rf voltage across the 200-picofarad capacitor will be a bit higher than that of the capacitor in a conventional network. This is true, but I have been unable to induce any kind of arcing across the capacitor plates, no matter how much I twiddle the knobs. It can also be said that, if the fixed inductance is large enough, it will be possible to develop a series resonant circuit with the fixed inductance and capacitor. This is true, but you just don't make the coil that large.

Although I was able to obtain the parts for the unit rather inexpensively, even if new components are used, the price will still be quite low.

A lot of the fun was in developing the method used and generating the tables in which an easy quick understanding of how the basic L-unit works can be obtained. The knowledge of how the L-unit works is a valuable addition to any amateur's technical store of information. And so a bit of "magical math" proved to be a lot of fun and practical, too. ■

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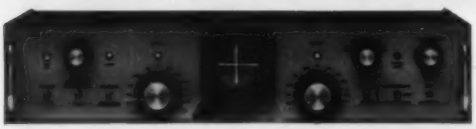

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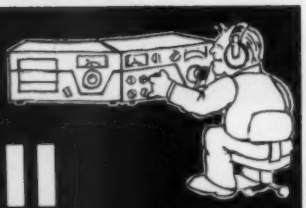

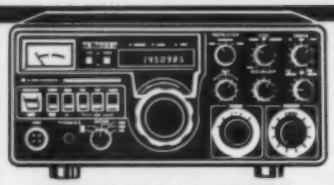

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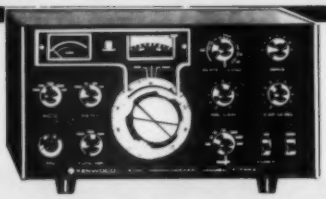

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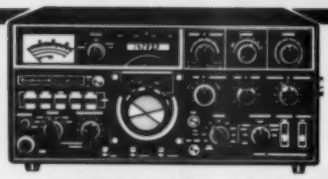

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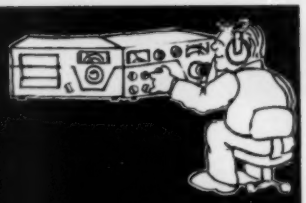

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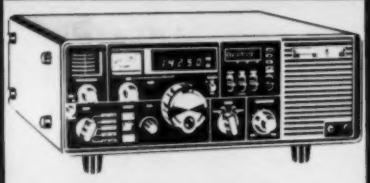

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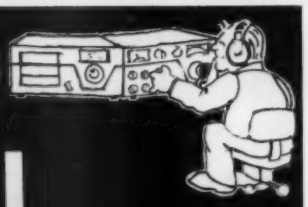

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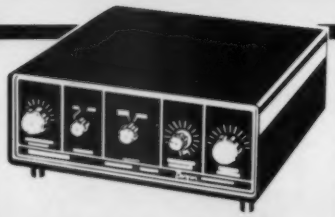

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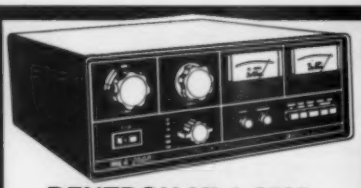

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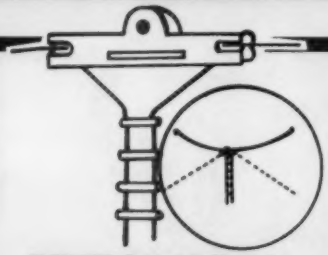

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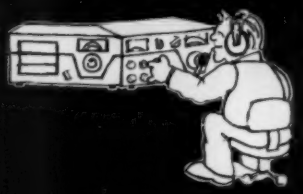

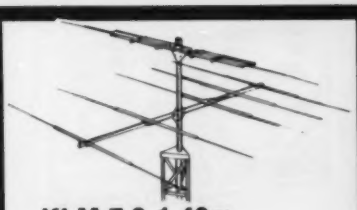

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May be mounted above, and on the same mast as your existing beam • High Q linear loading for low loss • Only 46 ft. long & weighs 15 lbs. • Element is split for direct 50 ohm feed • (KLM 3-60-1:1 balun optional 24:95). • Wind area 2 sq. ft. • Max. mast size 3".

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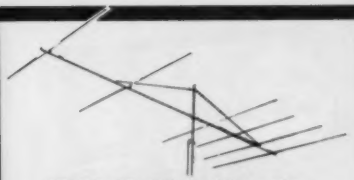

KLM-28-30-6 10 meter 6-element "Big Sticker" antenna

• Gain 11 dB plus or minus 0.3 db • Frequency range 28-30 MHz • Front to back 30dB typical • VSWR less than 1.5:1 • Longest element 18.33' • Boom length 27.52' • Wind area 4 sq. ft. • Feed impedance 200 ohms balanced • KLM-3-60-4:1 Balun optional 24.95.

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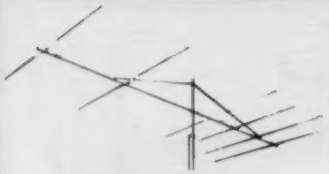

KLM-13.9-14.4-6 6 element 20m monobander

Freq: 13.9-14.4 MHz • Longest element 37.33 ft. • Gain 11.0 plus or minus 0.3dBd • Front to back. 35dB • Feed imp. 200 ohms balanced (KLM 3-60-4:1 balun opt. 24.95) • Boom length 57.25 ft. • Wind area 12.84 sq. ft.

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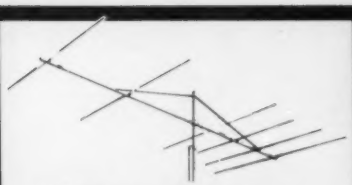

KLM-21-21.5-6 15m 6-element "Big Sticker" monobander

Freq: 21-21.5 MNz • Longest element 24.66 ft. • Gain 10.5 dBd • Front to back 30 dB typical • VSWR less than 1.5:1 Feed imp. 200 ohms balanced (KLM-3-60-4:1 balun opt. 24.95) • Boom length 38.5 ft. • Wind area 8.5 sq. ft.

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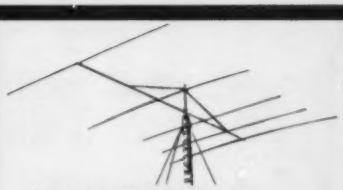

KLM-13.9-14.4-5 5 element 20m monobander

Freq: 13.9 - 14.4 MHz • Longest element 37.33 ft. • Gain 9.7 plus or minus 0.2 dBd • Front to back 30 dB typical • Feed imp. 200 ohms balanced (KLM-3-60-4:1 balun opt. 24.95) • Boom length 42 ft. • Wind area 9.25 sq. ft.

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KLM-28-30-5 10m 5-element "Big Sticker"

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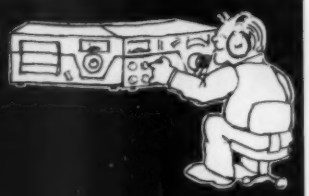

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Read forward or reflected power with maximum accuracy from 3.5 to 30 MHz. RMS readings available with the flick of a switch. Four scales from 0 to 2000 watts. Requires 117V AC power source.

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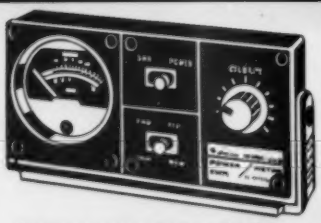

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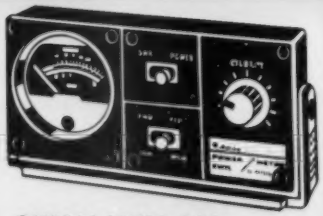

SWAN HFM-200 SWR and power meter

Frequency 1.8-30MHz • Two power ranges: 0-20 and 0-200 watts • VSWR 1:1-3:1 • For mobile installation, directional coupler may be located separate from main indicator • Meter is lighted for night use.

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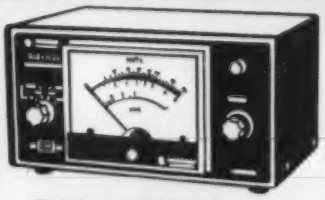

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Reads 20 and 200 watt scales • Includes expanded VSWR scale • Reads PEP or RMS values • Directional coupler permits reading of forward or reflected power from 50-150 MHz • Requires 117V AC in peak reading position.

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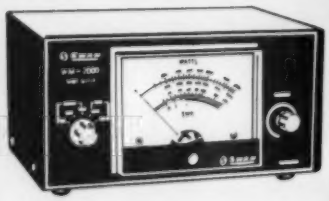

SWAN WM-2000 In-line wattmeter

Frequency range: 3.5 to 30MHz • 3 scales: 0-200, 1000, and 2000 watts • VSWR scale permits reading from 1:1 to 3:1 • Uses two SO-239 connectors.

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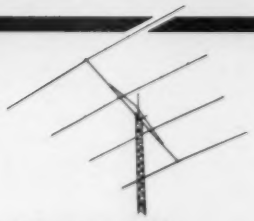

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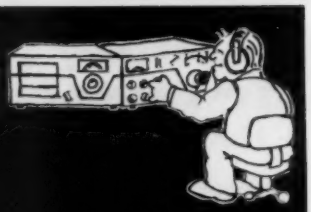

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W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 150

this was a new one. I used a car for a couple days during the Atlanta hamfest, keeping it parked in the hotel garage almost the entire time. I turned it in and went to the Budget booth to settle. They said that there was a dent on the car and that this would cost an extra $250. This got my attention.

Normally, I report to an airport a few minutes before my plane is scheduled to load, but for some reason on this day, we arrived a couple of hours early. The hamfest had closed, we'd had to check out of the hotel by noon, and our flight didn't leave for Los Angeles until 6 pm. Having the time, I grabbed my camera case and went back to the place I'd dropped off my car, making sure that the booth called 'em and told them to hold it.

I got to the parking area and the gal there said the car had already been sent to the garage. I said to dammit get it back, that I wanted to see that dent which was costing me $250. I hadn't noticed any dents and I knew darned well the car hadn't been touched while I was driving it.

It took a half hour to get it back, but it finally arrived. Atlanta was about 90° and I was boiling. I looked over the car and could find nothing. The gal then showed me a place under the driver's door where the body had been pushed in maybe a half inch. It looked like the body design, but sure enough, the other side had no indent. I looked for scratch marks and there were none. I can't even imagine how the dent was made . . . or if it was an old one and painted over. There was no scratch at all! I took pictures of the dent, of the girl, the booth, etc., and the next thing I knew I was told that the dent was not significant, that there would be no charge. Please don't worry about it.

To me, the whole act sounded like a ripoff. Most people would be catching a plane and would just have to trust Budget that the car was okay when they got it and dented now. I was lucky to have the time and the gall to challenge them.

You can bet that the next time I stopped at Atlanta, I looked over my car very carefully and made the girl at the parking lot make a note of the two dents. When I turned the car back, I asked them to see if the records for the car had any dents mentioned . . . none! It looked to me as if I was being set up again for the same scam. I made darned sure that they knew the dents had been there when I picked up the car, so I didn't have trouble.

Has anyone else run into this problem?

ONE LAST WORD

When the ARRL HQ chap said they *can't* take away the ham frequencies, I told him about my visit a couple days before to St. Pierre. In the museum are several copies of the newspaper warning residents that Mt. Pelee could blow up at any time and that they would do best to get away from that end of Martinique. Few people paid any attention to the newspaper warnings and in May, 1902, the volcano blew up and 40,000 people were killed in one day. There was one single survivor out of the entire population of the town.

HAM OF THE YEAR AWARDS

It has been a long time since there has been a significant award for hams who have been outstanding, and there should be such an award.

We should have some award for the ham who, in the estimation of the rest of us, has done the most to help amateur radio. This might be in a technical development, a pioneering effort, an emergency situation, or perhaps just plain hard work hamming such as in traffic handling or DXpeditioning.

In order to provide a recognition of work done to benefit amateur radio, *73* will award a "Ham of the Year" award each year at one of the major hamfests. Nominations for this award must be made by readers and each nomination must be accompanied by a sheet giving the reasons for the nomination in 500 words or less. Nominations from clubs citing a club member who is worthy of recognition are particularly solicited.

Nominations will be published in *73* and the readers asked to vote for the "Ham of the Year."

In the past, we have had several amateurs who were worthy of lasting honor. I can think of Lloyd and Iris Colvin for their exemplary DXpeditions. There is John Kraus W8JK and his antenna work. Sam Harris W1FZJ and his moonbounce work should have gotten an award. John Costas and his double sideband developments deserve mention. Jack Babkes W2GDG came up with narrowband FM—another winner.

The deadline for all nominations for "Ham of the Year" will be November 15, 1978. This will give us time to get them into the February issue of *73*. This in turn would allow a month for the readers to send in their votes and a winner could possibly be announced as early as March at Dayton.

Please be sure to mark all entries "Ham of the Year" when you send them in.

SAROC CANCELLED?

Rumor has it that the winter CES has put the kibosh on SAROC for January, 1979, and that, if it is to be run at all, it will have to be moved to some other dates.

There was no question that with CES in town there was no real room for any other shows. CES pulls 40,000 or more in attendance and has exhibits covering most of the consumer end of electronics. The 1978 CES in Vegas was a big hit with everyone who went to see it. I spent far more time there than at SAROC, as did almost everyone else.

SAROC is one hamfest we could well do without, anyway. It has been years since there has been a good program there and the attendance has been getting smaller and smaller, year after year, as hams find themselves without reserved rooms, and with nothing more than a few commercial exhibits to see for their money.

Tufts Electronics went to SAROC to exhibit last January and said never again. I heard the same comments from many other disillusioned exhibitors and attendees. It's a pity . . . the show is the right time of the year and in a good spot, if only it were run for amateurs instead of as a way to make a maximum amount of money for the chap who puts it on.

TEN LIVES!

The band plan for ten meter channelized communications is to move 27 MHz CB rigs up exactly 2 MHz, normally a simple change requiring a new crystal. This scheme puts channel 1 on 28.965 MHz. It is suggested that this be used as a listening channel in order to help alert channelized operators to band openings and to help with propagation studies. It is recommended that ten meter beacon transmitters running low power be set up on 29.005 MHz, which is channel 4. Those with 40-channel sets will be able to hear OSCAR on channel 40 and are asked not to transmit on this channel and thus perhaps interfere with OSCAR. Both the Standard and Bristol 10m sets are set up for this band plan. The Bristol Ham-100 transceiver runs 100 Watts and thus does not need a hard-to-get 10m amplifier. *73* is interested in reports of DX worked or any unusual contacts made using this channelized mode.

NEW GIMMICK

Last year, when I went to Washington to testify before the FCC on the subject of ten meter linear amplifiers, I told them flatly that trying to write rules against amateur radio equipment as a way to stem the tide of CB amplifiers was a waste of time. There is always a way for a crook to get around the rules.

Sure enough, the ink on the new regulations was hardly dry when the first mail-order ads for amateur radio ten meter CW transmitters were getting to CBers. The ads, followed a day or so later by a letter in a plain envelope which gave explicit instructions on converting the ten meter CW rig into a nice eleven meter linear amplifier, showed the usual cruddy design and construction we have come to identify with underground CB amplifiers. They obviously haven't gone very far underground.

So what is the answer? It is the same as it was when I testified before the FCC. If they want to curb this type of activity, the FCC has to bite the bullet and go after it strongly . . . and to hell with the political pressures. Well, both of us know that the FCC is never going to do such a thing. The CBers have too much clout and amateurs are almost totally impotent, so amateurs get it in the neck.

In view of the above, it is a bit difficult for me to get all uptight over the "ham" 10m CW rigs. How about you?

MAY WINNER

The most popular article in our May issue, as voted by our readers, was "Official FCC RFI Report," a reprint of a handbook produced by the FCC. At the suggestion of Mr. C. Phyll Horne, Chief of the Field Operations Bureau, we have donated the $100 prize to our favorite charity.

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Another Trick for the 22S

—now it's a remote control system

Richard M. Kriss WB7SHW
8130 Via del Futuro
Scottsdale AZ 85258

Like many Icom 22S owners, I have enjoyed expanding the frequency capability of the unit. The trick I have discovered is one that will be of interest to unmodified-IC-22S owners, as well as those who have the VIP-switch or the DIP-switch modification already incorporated.

Briefly, the trick is a modification of the DIP-switch programmer that was described in detail by WA4VAF in the June, 1977, issue of *73 Magazine*. The modification is to use three BCD switches in lieu of the 8-pin DIP switch.

For those interested in the programmer, I suggest you get a copy of Bill Richard's (WA4VAF) article entitled "More Channels for the Icom 22S." The article is an excellent explanation of how to activate channel 23 and how to bring the matrix board connections to the Icom's 9-pin accessory plug. Photo A shows how I implemented Bill Richard's basic modification. The significant difference (Photo B) is that I mounted the DIP switch on an umbilical cord and enclosed it in a box with magnets so that it could be mounted on the top of the radio. Note in Photo C that I did not use the PC board suggested in the article. The diodes are mounted on the DIP switch.

The DIP switch works fine. The only problem is

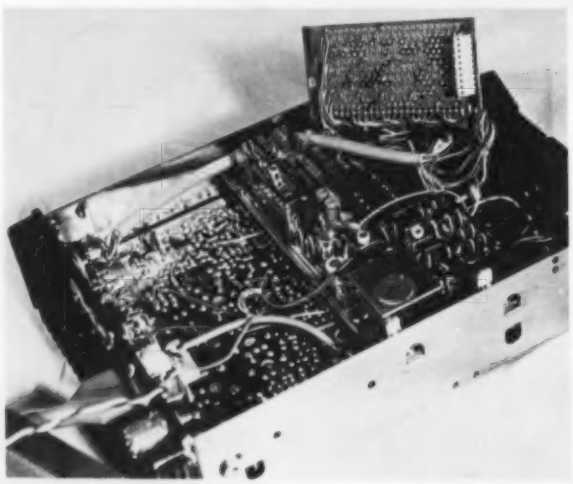

Photo A.

Top back view of BCD switch

NC	●	8	NC	●	8	NC	●	8
D2	●	4	D5	●	4	NC	●	4
D1	●	2	D4	●	2	D7	●	2
D0	●	1	D3	●	1	D6	●	1
9V	●	C	9V	●	C	9V	●	0

Back of BCD switch

From Icom 22S	#3	#2	#1 (thumbwheel position)
9 V	C	C	C (bus "C" together)
D0	1		
D1	2		
D2	4		
D3		1	
D4		2	
D5		4	
D6			1
D7			2

Note 1: Most BCD switches have connections on the back numbered C, 1, 2, 4, and 8 from bottom to top.
Note 2: The thumbwheel position numbers used above are numbered 1, 2, and 3, left to right, from the front view.
Note 3: Pin 8 on the BCD is not used, nor is pin 4 on position #1 (NC = no connection)
Note 4: The "C" positions should be tied together to bring the 9 volts into the BCD switch.
Note 5: Correct hookup is the key to the frequency lookup table in this article.

Table 1.

trying to push the right switches while mobile and trying to remember eight-digit numbers. I compared this problem with Jerry Armstrong WA7ZVT of Seattle, Washington. He gave me the idea and a lookup table for using a three-position BCD switch that several people in the Seattle area were using. Photos D, E, and F are pictures of my current programmer using a $1.95 three-position BCD switch. The key to the modification described in this article is the interface from the Icom 22S matrix

	Frequency	Switch		Frequency	Switch
	146.010	154		147.000	256
	.025	155		.015	257
	.040	156		.030	260
	.065	157		.045	261
	.070	160		.060	262
	.085	161		.075	263
	.100	162		.090	264
	.115	163		.105	265
	.130	164		.120	266
	.145	165		.135	267
	.160	166		.150	270
	.175	167		.165	271
	.190	170		.180	272
	.205	171		.195	273
	.220	172		.210	274
	.235	173		.225	275
	.250	174		.240	276
	.265	175		.255	277
	.280	176		.270	300
	.295	177		.285	301
	.310	200		.300	302
	.325	201		.315	303
	.340	202		.330	304
	.355	203		.345	305
	.370	204		.360	306
	.385	205		.375	307
Simplex	.400	206	Simplex	.390	310
	.415	207		.405	311
	.430	210		.420	312
	.445	211		.435	313
	.460	212		.450	314
	.475	213		.465	315
	.490	214		.480	316
	.505	215		.495	317
	.520	216		.510	320
	.535	217		.525	321
	.550	220		.540	322
	.565	221		.555	323
	.580	222		.570	324
	.595	223		.585	325
	.610	224		.600	326
	.625	225		.615	327
	.640	226		.630	330
	.655	227		.645	331
	.670	230		.660	332
	.685	231		.675	333
	.700	232		.690	334
	.715	233		.705	335
	.730	234		.720	336
	.745	235		.735	337
	.760	236		.750	340
	.775	237		.765	341
	.790	240		.780	342
	.805	241		.795	343
	.820	242		.810	344
	.835	243		.825	345
	.850	244		.840	346
	.865	245		.855	347
	.880	246		.870	350
	.895	247		.885	351
	.910	250		.900	352
	.925	251		.915	353
	.940	252		.930	354
	.955	253		.945	355
	.970	254		.960	356
	.985	255		.975	357
				.990	360

Table 2. Icom 22S BCD switch programmer.

Photo B.

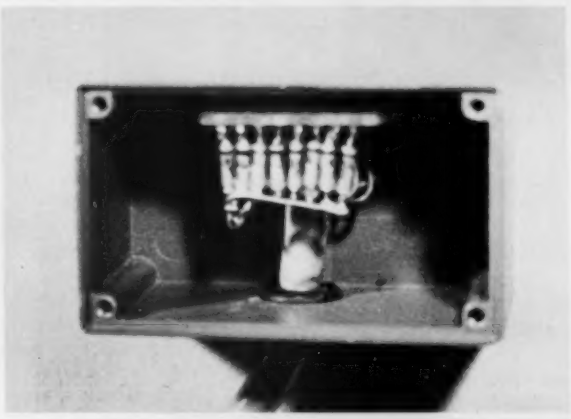

Photo C.

Photo D.

Frequency	Switch		Frequency	Switch
145.350	100		.800	136
.365	101		.815	137
.380	102		.830	140
.395	103		.845	141
.410	104	OSCAR	.860	142
.425	105		.875	143
.440	106		.890	144
.455	107		.905	145
.470	110		.920	146
.485	111		.935	147
.500	112		.950	150
.515	113		.965	151
.530	114		.980	152
.545	115		.995	153
.560	116	MARS and CAP frequency		
.575	117		148.005	361
.590	120		.020	362
.605	121		.035	363
.620	122		.050	364
.635	123		.065	365
.650	124	Out of band	.080	366
.665	125		.095	367
.680	126		.110	370
.695	127		.125	371
.710	130		.140	372
.725	131		.155	373
.740	132		.170	374
.755	133		.185	375
.770	134		.200	376
.785	135		.215	377

Table 3. Icom 22S extended range BCD switch program.

board to the BCD switch. By studying Photo F and Table 1, you should be able to make the modification with no problems. Note how the diodes and hookup wires are mounted on the switch. Be sure you cut the track on the switch to provide a mounting surface for the diodes.

Other keys to this modification are the lookup tables (Tables 2 and 3) that you can cut from this article for future use. The lookup tables give you the capability of going from 145.35 MHz (switch position "100") to 148.215 MHz (switch position "377") in 15 Hz steps.

In the Phoenix area, one is hard pressed to make use of all 22 channels of the standard Icom 22S, so I could not justify the expense of the $25 to $30 VIP switch. I do travel to other areas and like to have the capability to temporarily reprogram my 22S. The DIP switch gave me this capability, but the BCD programmer is easier to use and may be of interest to other Icom 22S users. It can be used with the VIP switch to pick up the missing frequencies.

As indicated, I do not claim credit for this modification. Credit goes to Bill Richards WA4VAF for the DIP switch idea, Jerry Armstrong WA7ZVT for the BCD conversion, Nick Hall WB7RZR for the photographs, Jack Hanny WB7SAF who revised the lookup tables, and Earl Sexton who helped me with the assembly. ■

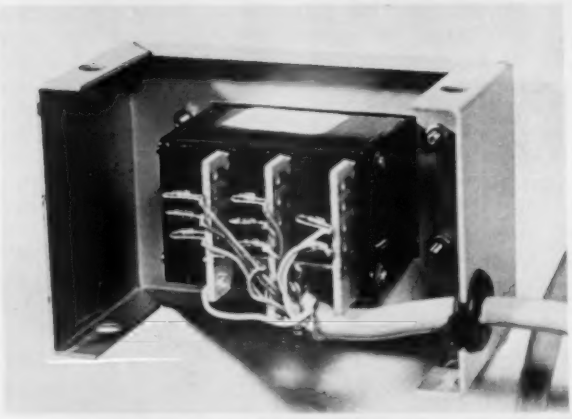

Photo E.

Photo F.

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3550W	50HZ-550MHZ	TCXO 1PPM 65° to 85°F	25MV	25MV	75MV	8	.5 inch	115VAC or 8.2-14.5VDC	2¼"H x 8"W x 5"D
3240HH	2MHZ-250MHZ	3PPM 65° to 85°F	100MV	100MV	NA	7	.4 inch	4AA Batt.	5"H x 3"W x 2"D

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"Stop Timeouts!" Revisited

—PC board for K3VTO's timer

I read with great interest the article "Stop Timeouts!" by K3VTO in the May, 1977, issue of *73*. It is nice to know that others have trouble getting electrons to go where the schematic diagram indicates they should go. After reading the article over several times, I decided to build the 10-minute timer even though I had no experience with TTL circuitry. I also thought that this would be a good time to try my hand at designing a printed circuit board to avoid the rat's nest of wires.

I purchased several packages of printed circuit (PC) drafting aids (Heathkit) and began the task of transforming K3VTO's circuit diagram to a printed circuit diagram that I could photoprocess onto a copper PC board. I checked and double-checked the wiring to be sure that I didn't leave out a connection. Finally, the drawing was complete and I was ready to transfer the diagram to the copper board. Needless to say, I spent several evenings and one weekend trying to photoprocess my circuit board. I even followed the suggestions of KL7AE on page 57 of the April, 1977, issue of *73*.

At last, I got an image on the copper, and, within minutes, I had the printed circuit board ready for drilling the many holes.

I mounted all the goodies on the board, connected the 6.3 V transformer to the power supply section, and, without fear, plugged it in. Alas, the decimal point did not blink, the readout remained on "8" no matter what, and the alarm howled constantly. I again checked the wiring diagram against the PC board and could not find any apparent discrepancies. So I checked with several other hams and was informed that TTLs must be attached to Vcc (+5 volts) before they will function properly. Also, they suggested that all unused connections be tied to Vcc. So I connected pin 16 of the 7448 and pin 14 of the 7400 to Vcc and pin 7 of the 7400 to ground (these connections were omitted from K3VTO's diagram).

With that, the timer was working with just a few glitches. After replacing several of the ICs, the timer finally worked as well as K3VTO claimed.

I made several changes in the schematic when I designed the PC board. I used a dual 555 IC (556) instead of 2 single 555s and provided connections for a variable volume control. Fig. 1 shows my PC board

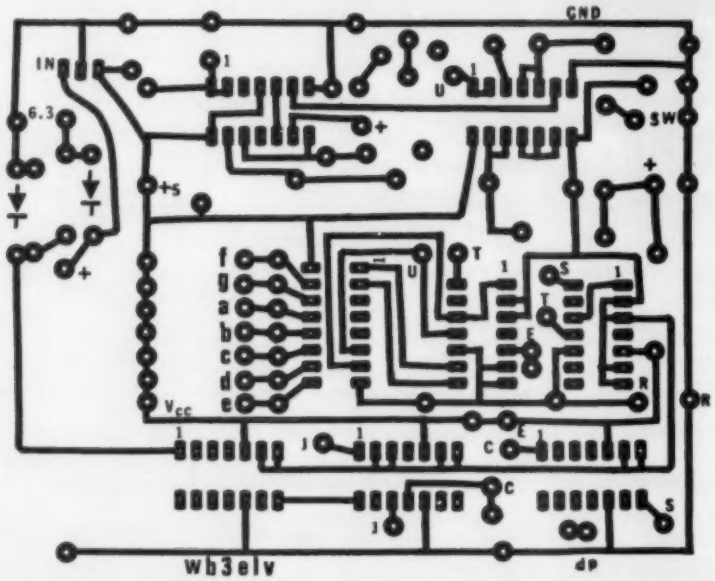

Fig. 1. PC board for 10-minute timer, including the 5-volt power supply.

design, which includes the +5-volt power supply. No provision was made to mount the 6.3-volt transformer on the PC board. I found a 2 x 4 x 6-inch enclosure at Heathkit which works quite well even with the larger readout (0.8 LED).

I must admit that, if the circuit had worked the first time, I would only have a 10-minute timer and would still not know anything about TTL circuitry. As it is now, I have studied and experimented with simple TTLs to the point where I can even check them for proper operations before using them in a circuit. I feel that the kinds of projects that are featured in *73* are beneficial to the beginner, as well as practical for the old-timers, and help prepare them for more sophisticated circuitry. ■

Predrilled PC boards are available from the author for $3.50 each.

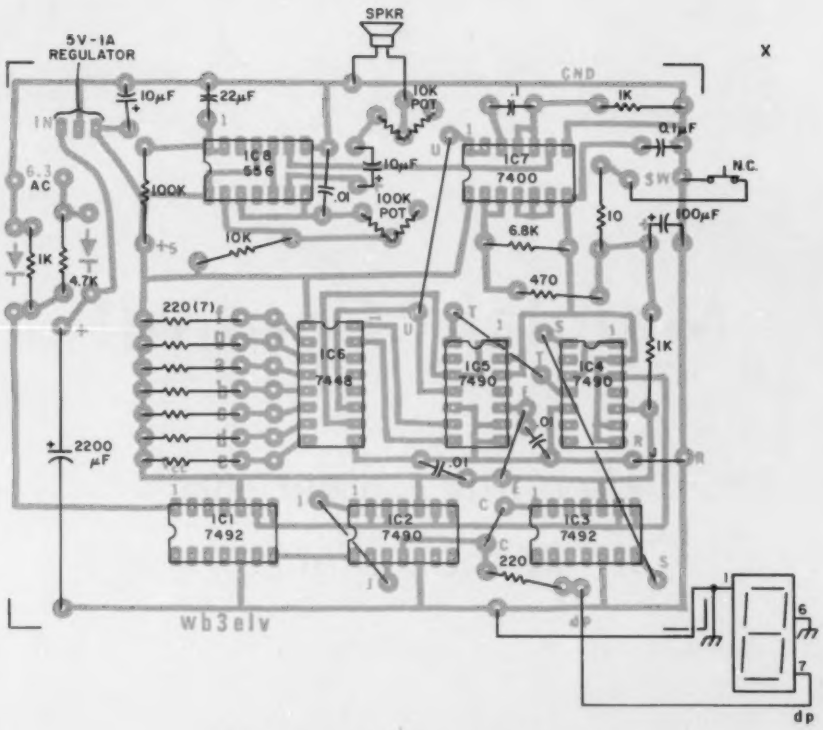

Fig. 2. Parts placement (foil side view).

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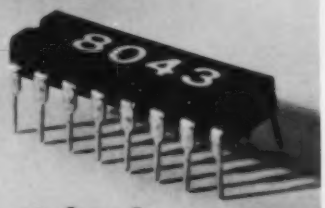

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J9

Maintain Control!

—keeping power tools in their place

David E. Stanfield
3408 Catalina Dr.
Atlanta GA 30341

No matter how carefully I use a center punch, it seems that the bit invariably slips as soon as I trigger an ordinary electric hand drill. And, most of the time, the bit will suddenly bite into the metal after it has slipped out of place. When this happens, I end up with a hole in the wrong place. If this isn't an earth-shaking problem, it is certainly annoying.

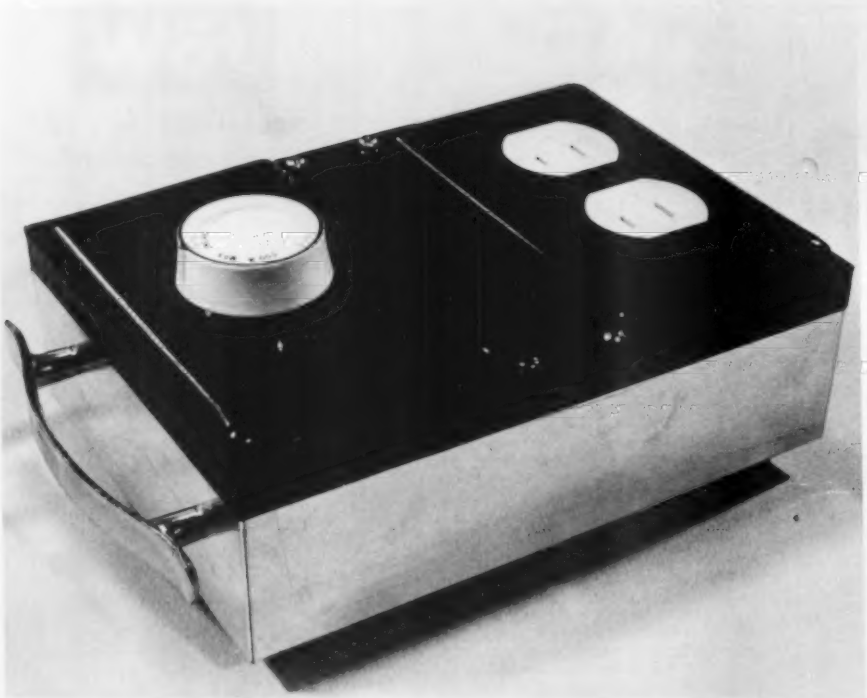
My method of dealing with this situation is simple and easy to apply. It is low in cost and can be used for a number of applications. It makes a great project for the beginner but can also be used by the pro.

Essentially, what I did was wire a light dimmer control in series with an ac socket and mount everything in a box. When I plug an electric drill into the socket, I can conveniently control its speed by turning the knob on the dimmer. At very low speeds, the bit doesn't try to wander off. Once I have the hole started, I can crank up the speed and finish the job.

After I built the unit shown in the photo, I found that I could use it to control the speed of a saber saw. Low speeds make it easy to start cuts accurately. Once started, I found it easier to control the saw by running it at about half speed.

I also found that the unit does a fine job of controlling the tip temperature on my soldering iron. Due to thermal lag, it takes a little time to find the proper setting of the knob, but, once you find it, it's easy to reset. This allows you to operate at reduced temperatures when soldering sensitive parts and then pour it on when you need extra heat.

Finally, I use this unit to control up to 600 Watts of photographic flood lamps. Before, my only means of regulating the intensity of light on the subject was to move the lamps closer or fur-



As this photo shows, the unit is fairly compact. What isn't shown is how easy the whole project is to put together.

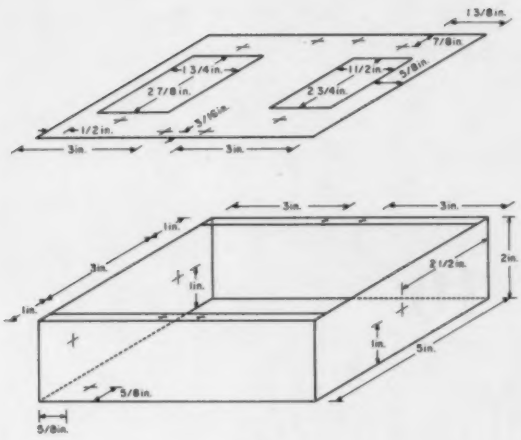


Fig. 1.

Parts List

Chassis – 5 x 7 x 2 inches, Radio Shack catalog number 270-246
Ac wall socket
Ac extension cord – 6 feet long (used as power cord)
Ac wall socket cover
Ac wall switch cover
Handle–kitchen cabinet type
Light dimmer control, 2-wire type
Machine screws, nuts, and lockwashers
Wire caps
Hookup wire
Rubber feet
Self-adhesive paper
Sheet of scrap wood 5 x 7 x 1/8 inches (for top piece)

ther from whatever I was photographing. Now I turn a knob. I should add that this procedure isn't recommended for color work, as the shift in color temperature is quite pronounced.

There isn't much point in my giving detailed instructions for a project as simple as this. Fig. 1 can be used to locate the holes and openings in the chassis and top plate, if you wish to duplicate my unit. All but four of the holes are drilled slightly larger than the machine screws which will pass through them. These screws are then secured with nuts and lock washers.

On opposite sides of the top of the chassis are two ridges. The four holes I drilled in them are used to fasten the top plate and are drilled slightly smaller than the screws used in them. If care is used, these screws will act as self-tapping screws and thread their way through the ridges. This eliminates the need for trying to use nuts

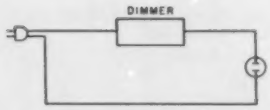


Fig. 2.

under the ridges, which would be difficult, at best.

And finally, the hole drilled in the right end of the chassis is used for the power cord. It must be drilled large enough for both the power cord and a protective grommet. As you can see in the photo, I used self-adhesive paper to cover the top and seal it to the chassis. A sharp hobby knife made trimming excess paper an easy task. The handle makes it a very portable unit and serves as a good place to wrap the cord. I didn't include an on/off switch, as one is built into the dimmer. If you don't care for the uses I've suggested for this controller, you can always use it to dim room lamps. What you do with dim lighting is beyond the scope of this article. ■

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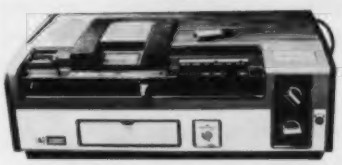

We are constantly testing ham and other electronic equipment for review in 73 Magazine. In order to be able to keep this not inexpensive project going we have to sell off the equipment used for test. Most of it has been used for a few days and is in every way as good as new. In many cases it is better than new since 95% of the equipment failures come within the first few hours of operation.

In this case we are running a series of tests of VTR systems, using them for regular, ham TV, SSTV, and even microcomputer programming tests. One of the best we've found so far is the Quasar system, but we still have to go on and test the RCA, JVC, and many other systems . . . so our Quasar is up for sale. We paid well over $1,000 for the Quasar . . . used it for a few days and have gone on to test more systems.

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CB to 10

—part XI: Hy-Gain's PLL rigs

Almost every late-model CB rig on the market is capable of operating on 10 with excellent sensitivity and output. No model requires very extensive changes to modify. I picked an inexpensive and easily converted rig for my first research run and achieved some rather gratifying results. A little fancy telephone work got me in touch with Charlie Conners KØNG in Nebraska, who I knew had spent many hours in design work on PLL circuits. As it turned out, Charlie has done extensive work on 10 meter conversions, and, without his advice and knowledge, my conversion could have been very painful the first time.

The Hy-Range model 681A,[1] which I chose for conversion, can be modified in about an hour and performs well (better than manufacturer's specs). Is it phase locked loop? You bet — it only requires the purchase of one crystal instead of two, four, or possibly six on some rigs, and the receiver sensitivity is right on with a little realignment. No circuit changes are necessary, and there is no compromise on sensitivity.

Do I have you interested? Get out your alignment tool, VTVM, and signal generator (necessary equipment), and set aside one hour of your day's schedule.

Finding your way inside should be no problem. Locate X101 and replace it with a new crystal which is determined by the formula: (N/2) + 9.510 MHz, where N = kHz above CB channel 1 (26.965) that you wish to operate.

For example, suppose we move up exactly 2 MHz to 28.965 for channel 1. Then, 28.965 - 26.965 = 2000 kHz; 2000/2 = 1000 kHz or 1 MHz; 1000 kHz + 9.510 = 10.510 MHz for new crystal frequency.

With the new crystal installed, set the channel selector to channel 1, attach a VTVM to TP8 on the PC board (junction of R114 and R115), and adjust T101 for 1.5 V dc ± .1 volt. This step is critical and must be done carefully, as it allows the vco to operate within "capture" range of the PLL circuitry. This accomplished, loosely couple an accurate signal source to the antenna jack, flick the channel selector to channel 11, and carefully peak T104, T105, T106, L112, and L115 for maximum receive sensitivity.

Next, attach a power meter and dummy load to the output and key up the transmitter. Watch the power meter and tune T102, T103, L103, L104, L106, L109, and L110 for maximum power output. If the power output exceeds 4 Watts at this point, readjust L110 counterclockwise until it is 4 Watts or less. This last step will assure an output free of spurious radiation. Also, remember that these adjustments are interactive and should be gone over more than once for peak performance.

And there you are! It's a first class 10 meter rig in anybody's book — in about an hour.

Now you need an antenna for the little jewel. There is one CB antenna on the market that will operate "as is" on 10 with less than 2-to-1 swr through a full megahertz. The M400 "Starduster" made by Antenna Specialists is a natural, the only modification necessary being to change the coax connector from the CB rig to the 10 meter rig. But, for the ham who's got to have everything just right, slip the capacitance hat off the top radiator, prune the radiator to 96" and the three radials to 98", and you have a fine vertical antenna which will show unity gain with a good dipole.

A mobile antenna presents little more difficulty than a simple retuning. Most commercially produced mobile CB antennas fall into three categories, and all can be modified successfully with very little effort. Quarter-wave whips are simply pruned to resonance with an swr meter in the line. Center- and top-loaded antennas usually have an adjustable metal whip which requires a slight shortening.

Helically wound antennas may be carefully shortened and resealed against the weather. There's nothing really difficult about the conversion, and most can be accomplished in 30 minutes or so.

By this point, you should have under $100 and about an hour and a half worth of time invested in a slick 10 meter station. ■

Reference

1. Hy-Gain model 682 uses the same conversion. Models 2680, 2681, 2682, and 2683 require a different crystal formula: Crystal X101 = N/3 + 11.80666 MHz, but tune-up is exactly the same. Service manuals (very comprehensive) are available from: Hy-Gain Electronics, 4900 Superior St., Lincoln, Nebraska 68504, for $5 each.

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N.E. Convention Escapes to Country

Conventioneers and city dwellers alike breathed a sigh of relief when the news was released from Newington. The New England ARRL Convention, formerly held in Boston for several years was moved to the tiny hamlet of Boxborough, Massachusetts on Interstate Route 495. Free parking and easy access were given as two main reasons for the move. Home of the big show will be the Sheraton Boxborough Hotel, Exit 28, Route 495.

Prizes Awarded Both Days of Show

Through the generous cooperation of the manufacturers and exhibitors lucky conventioneers will be taking home transceivers, antennas, microphones, amplifiers . . . the list goes on endlessly.

The event is a non-profit affair and surplus funds go directly into the prize fund.

Every Manufacturer Will Attend

Virtually everybody who is anybody will be there. A partial listing at presstime included Icom, HyGain, Dentron, Tufts, 73, Spectrum International, Mosley, Drake, ARRL, Ham Radio, Yaesu, CushCraft, Robot, Atlas, Ten-Tec, Digital Group, CQ, Kenwood, Byte, Tri-Ex, Hamtronics, Harrison, Science Workshop, TPL, ETO, Newtronics, HAL, Heath, Bay State, Evans, Radio Shack, Alda, DSI, Tel-Com, Harco, etc., etc.

Big Events All Weekend

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If you intend to perform experiments that require dual power supplies and you only have a single-ended supply, then the circuit in Fig. 1 is for you. Pin numbers are for the mini-DIP or TO-5 packages.

Actually, it is nothing more than a voltage follower, just textbook stuff, but maybe not widely known in hobbyist circles. As its name implies, the operational amplifier, by virtue of its intrinsic properties, will cause the voltage at its output to follow the voltage impressed upon its noninverting input. This voltage can be conveniently selected by means of a potentiometer.

The op amp's output will then play the role of a "synthetic" ground, and you will enjoy the possibility of selecting the potential of the ground terminal, provided that it does not come closer than 3 volts to either supply line.

In addition to the above limitation, the maximum current output of the op amp will dictate the maximum current differential between the two branches of the circuit that it can handle. If the two currents are identical, the op amp will be just loafing along and, theoretically, there will be no current whatsoever flowing into or out of the op amp. If, however, one of the two branches draws more current than the other, the op amp will have to source or sink that difference. See Fig. 2. The arrows indicate conventional current flow.

The 741, like most other op amps, is internally protected against short circuits and can indefinitely withstand a short between its output and either supply line. Therefore, do not be afraid of blowing up the device. If you try to exceed its capabilities, it will just refuse to cooperate, and you will lose control of the voltage at the ground terminal.

This limitation raises another question: How much current can you expect out of this circuit? There is not one single answer to this question. If the positive and negative currents are nearly identical, the limitation will be imposed by the capabilities of the single-ended supply, but if, on the other hand, those currents differ widely, the limitation will be imposed by the maximum output of the 741. It so happens that this device was never intended to be a current driver and, in fact, manufacturers do not guarantee or even specify the current that you can expect out of one of those little beasts. If you sift through available literature, you will see this parameter quoted at anywhere between 5 and 15 mA.

Confronted with this situa-

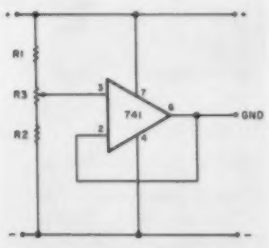

Fig. 1. Pin numbers are for the mini-DIP and TO-5 packages.

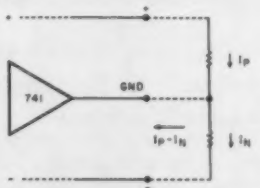

Fig. 2(a). Current at the positive branch is greater.

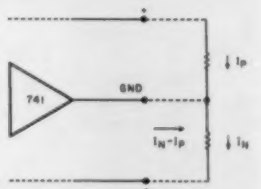

Fig. 2(b). Current at the negative branch is greater.

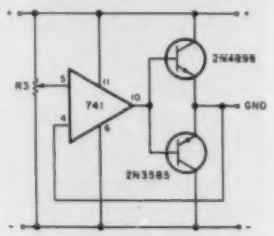

Fig. 3. Pin numbers are for the 14-pin DIP.

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tion, I decided to find out for myself and, scrounging around, was able to gather some twenty-five different units from several manufacturers and in different packages. Their short circuit current was measured with unexpected results: Mini-DIPs and metal cans gave about 16 mA, whereas 14-pin DIPs gave a surprising 30 mA!

Inasmuch as the output current limitation is temperature dependent, I also ran some tests with heat sinked DIP packages with inconclusive results, and it is doubtful whether it is worth the trouble.

There are in existence other op amps capable of greater current output, but they are not only difficult to find, but expensive, as well. The circuit of Fig. 3 is a more practical solution if the unaided 741 is not capable of delivering the performance you need. I designed this circuit after unsuccessfully trying 2 different designs published on separate occasions by trade magazines. The first design only worked if the negative branch drew a heavier current, and the second one was plagued by oscillations.

Device	Polarity	BV_{CBO}	BV_{CEO}	BV_{EBO}	I_C	P_d	Condition
S9101	NPN	60	60	5	4 A	40 W	Ambient T = 25°C
S9121	PNP	60	60	5	4 A	40 W	Ambient T = 25°C
TIP 110	NPN	60	60	5	2 A	50 W	Case T = 25°C
TIP 115	PNP	60	60	5	2 A	50 W	Case T = 25°C

Table 1.

In the unit I built, which is now a permanent fixture of the workbench at CT1EM, I used 2N4898 and 2N3585 transistors for the simple reason that they were available from my junk box. Any power transistor in a TO-66 or TO-220 package should be okay. It would be futile to try a big brute like a 2N3055 because the 741 would be unable to provide the base current necessary to fully exploit its power capabilities. With the transistors above, my unit can provide currents with an imbalance exceeding 1 Amp.

If you are still not satisfied with that, you may use Darlington amplifiers instead of plain transistors. These amplifiers from the outside look just like any transistor, and they are inserted in a circuit as if they were just that. The main characteristic of such devices is a phenomenal static current gain. Therefore, the skimpy current output of even a 741 will be sufficient to provide the necessary base drive. Suitable devices would be Motorola's HEPS9101 and HEPS9121. Texas makes the TIP 110 and the TIP 115, which are lower in power capability and would require heat sinking. See Table 1 for the main parameters.

On the schematic, R_1 and R_2 are optional and, if installed, should be about 10% of R_3. The pot should be about 50k and the bypass capacitors (from ground to the supply rails) should be .1 ceramic disc. It will be advantageous to use the 14-pin package, rather than the mini-DIP or metal can, and have all pins soldered to the board rather than socketed, for improved heat transfer.

Before you decide to go the Darlington way, make sure that your power supply has enough beef to exploit the performance afforded by the very high current gain of these devices. Remember that the tremendous amplification is obtained only under static conditions and falls off quite rapidly with increasing frequency. Eventually you may run into a circuit whose current demands fluctuate too rapidly for the Darlington to follow. ■

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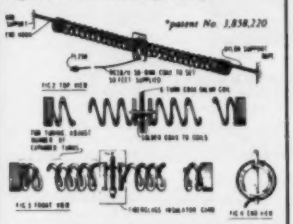

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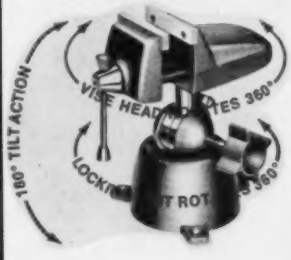

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209 Mystic Avenue
Medford MA 02155
(617) 395-8280

TUFTS RADIO CATALOG TUFTS RADIO

THOMSON-CSF NPC ELECTRONICS

MODEL	NET PRICE	MODEL	NET PRICE
12V4	$19.95	104R	$49.95
102	$24.95	108RA	$79.95
107	$28.95	108RM	$99.95
103R	$39.95	109R	$149.95

MODEL 109R

NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ± 200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ± 2VDC	13.6 ± 3VDC
Line/Load Regulation	20 mV	100 mV
Ripple/Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	28 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ± 200 millivolts. 6 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ± 2VDC	13.6 ± 3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	6 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4¾" (H) x 7½" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ± 200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ± 2 VDC	13.6 ± 3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3" (H) x 5" (W) x 6" (D). Shipping Weight: 6 lbs.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 6¾" (D). Shipping Weight: 5 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for dual applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	13 V min
Filtering Capacitor	6,000 uF
Ripple (Full Load)	4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5½" (D). Shipping Weight: 3 lbs.

MODEL 103R

NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ± 200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ± 2 VDC	13.6 ± 3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4½" (W) x 5½" (D). Shipping Weight: 4 lbs.

MODEL 102

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

Functions silently in converting 115 volts AC to 12 volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	6 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 6¼" (D). Shipping Weight: 4 lbs.

ADVANCED ELECTRONIC APPLICATIONS, INC.

The AUTO DIALER that really works!

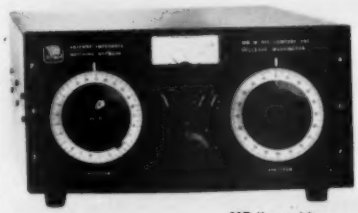
- you get 18 numbers from a 1-2 punch
- for making **Quick** and **Safe** Auto-Patch Calls
- with Key-Pad Programmable Memory

Made in USA

Model AD-1 $129.95

Check These Features:

- Automatically dials with 1 or 2 buttons
- Exclusive MOS Microprocessor
- Automatic Push-to-talk
- Programmable tone duration
- Programmable time between tones
- High quality tactile Key-Pad
- Built in speaker
- Program RAM memory with Key-Pad (10 numbers in less than a minute)
- Optional ROM adds 8 permanent numbers
- Crystal controlled
- Mates with virtually all amateur FM transceivers



NyeViking

Model MB II $285 (with Balun) $315

MB II provides:

★Constant SWR monitoring. ★Precision tuning of final amp. ★Harmonic suppression. ★Receiver input impedance-matching. ★Maximum power transfer to antenna. ★Continuous frequency coverage 1.6 to 30 MHz. ★Precision tuning of any wire ½ wavelength or longer, with SWR of 1:1.

MB II features:

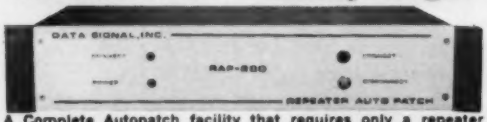
★Finest quality, made-in-USA components. ★Large, precision, easy-to-read dials with 360° readout. ★Optional 3000 watt Balun for twin lead antennas.

TRIPLETT

- Drop-resistant, hand-size V-O-M with high-impact thermoplastic case.
- 20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused Rx1 Ohms range.
- Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.

RANGES
DC VOLTS: 0-3-12-60-300, 1, 200 (20,000 Ohms per Volt).
AC VOLTS: 0-3-12-60-300-1, 200 (5,000 Ohms per Volt).
OHMS: 0-20k-200k-2m Ω -20M Ω (200 Ohm center scale on low range).
DC MICROAMPERES: 0-600 at 250 mV.
DC MILLIAMPERES: 0-6-60-600 at 250 mV
ACCURACY: ±3% DC; ±4% AC; (full scale).
SCALE LENGTH: 2-1/8".
METER: Self-shielded; diode overload protected; spring backed jewels.
CASE: Molded, black, high impact thermoplastic with slide latch cover for access to batteries and fuse, 2-3/4"w x 1-5/16"d x 4-1/4"h.
BATTERIES: NEDA 15V 220 (1), 1½V 910F (1): Complete with 42" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 2 lbs.
MODEL 310 Cat. No. 3018 $53.00

AUTOPATCH — Ready to go!



A Complete Autopatch facility that requires only a repeater and a telephone line. Features include single-digit access/disconnect, direct dialing from mobile or hand-held radios, adjustable amplifiers for transmitter and telephone audio, and tone-burst transponder for acknowledgement of patch disconnect.

RAP-200 P. C. Card $199.50
RAP-200R Rack Mount $249.50

Autek Research QF-1 Active Filter

For CW & SSB
$59.00

AUTEK pioneered the ACTIVE AUDIO FILTER way back in 1972. Today, their fantastic performance is widely acclaimed. But, today, we're still way ahead with the most advanced — our QF-1. Thousands are already in use improving Yaesu, Kenwood, Drake, Swan, Atlas, Tempo, Collins, etc. Hooks up in minutes to **ANY** rig. Plugs into phone jack. Drives a speaker with 1 watt, or phones.

Its secret is an exclusive "infinitely-variable" cascaded design. You can vary frequency over the **ENTIRE** audio range — 250 to 2500 Hz — in all positions. Vary selectivity 40:1 or more. Instantly zero-in on signals or optimize response! **PEAK** CW or voice with 50 Hz bandwidth, variable to 2000 Hz. Imagine what the **HARROWEST CW FILTER MADE** will do to QRM! Reject whistles, carriers, etc. with the most flexible **NOTCH** you've heard. Wide or narrow. Depth to 70 dB. Cope with SSB hiss and splatter in **LOW-PASS.** Steep skirts in all positions add to your rigs skirts.

EXPERIENCE the Ultimate in Scanners

The Touch.™ by Regency

- Over 15,000 frequencies at your fingertips
- Scans the Channels in 1.3 Seconds
- Special Weather Alert® and Priority Scan features

$249.95

Most Orders shipped the same day

Most Orders shipped the same day

LINEAR AMPLIFIER
Model L-4B

L-4B Linear Amplifier . . $995.00 ● 2000 Watts PEP-SSB ● Class B Grounded-Grid — two 3-500Z Tubes ● Broad Band Tuned-Input ● RF Negative Feedback ● Transmitting AGC ● Directional Wattmeter ● Two Tautband Suspension Meters ● L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs. ● Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.

Drake T-4XC
Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability. Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. Four 500 kHz ranges in addition to the ham bands plus one fixed-frequency range can be switch-selected from the front panel.

Drake R-4C
Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability. Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. In addition to the ham bands, tunes any fifteen 500 kHz ranges between 1.5 and 30 MHz, 5.0 to 6.0 MHz not recommended. Can be used for MARS, WWV, CB, Marine and Shortwave broadcasts.

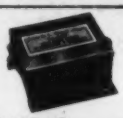
Touch-n-go with DRAKE 1525EM

Push-Button Encoding Mike
Drake 1525EM, microphone with tone encoder and connector for TR-33C, TR-22, TR-22C, ML-2 —
- Microphone and auto-patch encoder in single convenient package with coil cord and connector. Fully wired and ready for use.
- High accuracy IC tone generator, no frequency adjustments.
- High reliability Digitran® keyboard.
- Power for tone encoder obtained from transceiver through microphone cable. No battery required. Low current drain.
- Low output inpedance allows use with almost all transceivers.
- Four pin microphone plug: directly connects to Drake TR-33C without any modification in transceiver. Compatible with all previous Drake and other 2 meter units with minor modifications.
- Tone level adjustable.
- Hang-up hook supplied.

DRAKE TR 7 TRANSCEIVER

DRAKE TVI FILTERS
High Pass Filters for TV sets provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Drake TV-300-HP
Model No. 1603. For 300 ohm twin lead



Drake TV-75-HP
Model No. 1610. For 75 ohm TV coaxial cable; TV type connectors installed

LOW PASS FILTERS FOR TRANSMITTERS have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

DRAKE TV-5200-LP Model No. 1609. 200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP.

Drake TV-3300-LP Model 1608 1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems.

DRAKE TV-42-LP Model No. 1605 is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input.

DRAKE

COMMUNICATIONS RECEIVERS AND ACCESSORIES

DSR-2	VLF-HF Digital Synthesized Communications Laboratory Receiver SSB, AM, CW, RTTY, ISB	$ 3200.00
R4C	Amateur HF Receiver, 160-10 meters	699.00
4-NB	Noise Blanker for R4C	74.00
FL-250	Accessory I.F. Filter	52.00
FL-500	Accessory I.F. Filter	52.00
FL-1500	Accessory I.F. Filter	52.00
FL-4000	Accessory I.F. Filter	52.00
FL-6000	Accessory I.F. Filter	52.00

TRANSCEIVERS AND ACCESSORIES

TR-7	HF Transceiver 160-10 meters Analog Dial Readout	886.00
DR-7	Digital Readout/Gen. Cov. Board Allows continuous receive from 1.5-30 MHz	186.00
TR-7/DR-7	Above units, factory installed DR-7	1072.00
Aux-7	Range Program Board for TR-7 and TR-7/DR-7 Allows receive 0-1.5 MHz and transceive or receive 1.5-30 MHz. Accommodates any 8 500 kHz ranges. Must be used with either RRM-7 range receive module or RTM-7 range transceive module. Use one mode per 500 kHz range. Modules are customer programmable, instructions provided. Proof of license necessary for RTM-7, contact sales dept.	38.00
RRM-7	Range Receive Module — plugs in to Aux-7. Customer Programmable in any 500 kHz range 0-30 MHz.	5.00
RTM-7	Range transceive module — plugs in to Aux-7. Customer Programmable in any 500 kHz range from 1.5-30 MHz except 26-28 MHz. Send proof of license.	5.00
RV-7	Remote VFO for TR-7	156.00
FA-7	Fan for TR-7 or PS7	24.00
NB-7	Noise Blanker for TR-7	74.00
SL-300	Crystal filter, 300 Hz	49.00
SL-500	Crystal filter, 500 Hz	49.00
SL-1800	Crystal filter, 1800 Hz	49.00
SL-6000	Crystal filter, 6000 Hz	49.00

TRANSMITTERS

T4XC	Amateur HF Transmitter 160-10 meters	699.00

TRANSCEIVERS AND ACCESSORIES

TR33C	2-meter FM transceiver, 12 channel portable	229.95
MMK-33	Mobile/Dash/Desk Mount for TR33C	12.95
UMK-3	Remote trunk kit for UV-3 system	69.95
UV-3	144	595.00
UV-3	144-220	695.00
UV-3	144-440	695.00
UV-3	144-220-440	795.00
UV-3E	144-430, European model	695.00
*Prices above include factory installed modules for bands as listed. Factory installed "add-on" 220 or 440 modules. (Modules not sent to field).		175.00

POWER SUPPLIES

AC-4	110/220V power supply for 4 line transmitters and transceivers	150.00
PS-3	AC Supply [120/240 V.A.C.] for any UV-3 Model	89.95
DC-4	12 VDC power supply for 4 line transmitters, transceivers, & receivers	160.00
PS-7	120/240V A.C. supply for TR-7	166.00

MAJOR ACCESSORIES & MISCELLANEOUS

L-4B	Linear Amplifier with Power Supply & Tubes	995.00
MN4C	Antenna Matching Network, 160-10 meters, 250 watts	165.00
MN-7	Antenna Matching Network, 160-10 meters, 250 watts.	165.00
MN2000	Antenna Matching Network, 2000 watts.	250.00
B-1000	4:1 Balun Designed for use with MN4C/MN-7	24.95
MS-4	Matching Speaker for 4 line	33.00
MS-7	Matching Speaker for 7 line	33.00
W-4	HF RF Wattmeter 1.8 to 54 MHz 200/2000 watts	79.00
WH-7	HF RF Wattmeter 1.8 to 54 MHz 20/200/2000 watts	89.00
1525EM	Encoder Microphone w/plug for TR33C/UV-3	49.95
7079	Vinyl Case for TR33C	9.95

HIGH PASS FILTERS

TV 300HP	High Pass Filter for 300 ohm twin lead	10.60
TV75HP	High Pass Filter for 75 ohm TV coax, type F	13.25

LOW PASS FILTERS FOR TRANSMITTERS

TV42LP	For transmitting below 30 MHz, 100 watt continuous/50 ohms/SO-239 connectors	14.60
TV3300LP	1000 watts continuous to 30 MHz with sharp cutoff above MHz/50 ohms/SO-239 connectors	26.60
TV5200LP	100 watts continuous on 6 meter amateur band	26.60

TUFTS RADIO CATALOG — TUFTS RADIO

SWAN ELECTRONICS
A subsidiary of Cubic Corporation

MODEL	DESCRIPTION	AMATEUR PRICE
	BEAMS	
TB4HA	4 Element 20/15/10. All four elements function all bands and are full sized	$279.95
TB3HA	3 Element 20/15/10	$219.95
TB2A	2 Element 20/15/10	$149.95
MB40H	2 Element 40 meter	$219.95
	VERTICALS	
1040V	10-40 Golden Swan Trap	$122.95
75-MK	75 meter add-on kit for 1040V	$ 39.95
4010V	10-40 Slim-line trap	$ 79.95
75-AK	75 meter add-on kit for 4010V	$ 39.95
	MOBILE	
45	75/40/20/15/10, 1000W PEP Gold Plated contacts, Manual band switching	$119.95
742	75/40/20, 500W PEP, no manual switching required. Fully automatic after initial tune-up to desired frequency.	$109.95
M34	20/15/10 slim line tri-bander 500W PEP. Coil for 40 or 80 or 160 with top section may be added to make unit four bander.	$ 69.95
M34T	Top section used with 40/80 or 160 coils. Not required for basic M34.	$ 6.95
M34E	Base extender rod for use when mounting M34 on bumper.	$ 13.95
M34/160	160 meter coil (M34T required)	$ 21.95
M34/80	80 meter coil (M34T required)	$ 19.95
M34/40	40 meter coil (M34T required)	$ 19.95

*M34/11 27 MHz coil available only upon special request. Delivery six weeks. $16.95. May be utilized in lieu of 10 meter coil on basic M34.

NEW TRANSCEIVERS

750 CW—$879.95

If you're ready for 700 loud-talking watts, you're ready for the new 750CW.
- 700 watts P.E.P. input on SSB
- 400 watts DC input on CW
- CW audio filter selectable 80 or 100 Hz
- CW sidetone monitor with adjustable pitch and volume control
- 80 through 10 meters, USB, LSB, CW
- Selectable 25 or 100 KHz crystal calibrator
- Standard 5.5 MHz, 2.7 Hz bandwidth crystal filter or optional accessory 16 pole filter available with 140 Db ultimate rejection

Accessories
- VX-2 Vox
- MK-II Linear amplifier
- DD-76 Digital Dial

The 750CW is a CW man's dream come true. What's more there's a long list of accessories you can add later for increased performance.

350B—$649.95
- 300 watts P.E.P. input SSB
- 200 watts DC input on CW
- 80 through 10 meters, USB, LSB, CW
- 5.5 MHz, 2.7 KHz bandwidth crystal filter
- Oscillators are solid state and IC regulated for stability
- CW sidetone monitor with adjustable pitch and volume
- CW audio filter 80 and 100 Hz selectable
- Built in 117 VAC power supply and speaker. (220 VAC power supply available on special request)

Accessories
- VX-2 Vox
- 14A DC Converter
- 1200W linear amplifier

- Crystal Calibrator (350A only)

350D—$749.95
- Same basic features as 350A except added feature of:
- 6 Digit LED frequency display with readout to 100 Hz

Both the 350A and the 350D are compatible with the same line of Swan accessories that has built a reputation for reliability and performance that's second to none, including linear amplifiers to boost your power to the legal limit.

So they're perfect for novices or anyone else because you can build capability as you need it.

OUR NEW M-34 EXPANDABLE MOBILE ANTENNAS

The M-34 mobile antenna gives you 10, 15, and 20 meters and great performance in a tough, rugged design for only $52.75.

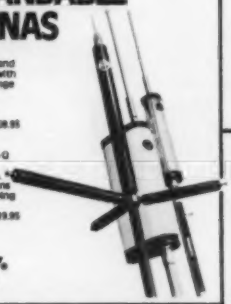
Then whenever you want it you can buy the optional 160, 80 or 40 meter coil and top section for $20.00 to $29.00 depending on the band and make a full-capability four-bander out of it. One that never needs coil changes or adjustments after initial tuning.

What's more, at no extra cost you get features like 500 watts PEP, low standing wave ratio at resonance, independent resonance adjustments on each of the four bands, exceptional bandwidth and a neat, clean, low-wind-resistance profile that also goes great with mobile homes, motor homes and apartments.

That's the kind of innovative, problem-solving thinking that goes into Swan mobile antennas. Not just the M-34 but these, too:

742 Automatic. Swan automates mobile antennas with the 742 tri-band antenna. Work 20, 40 or 75 meters with your 742 without need for coil change or other adjustments after initial tuning. A high Q mobile antenna designed for maximum efficiency capable of 500 watts PEP $109.95

Mobile 45. This switch-adjustable 3-band antenna features a Swan Hi-Q coil and positive-stop, 9-position switch with GOLD-PLATED contacts. Select 10, 15, 20, 40 plus five positions for 75 meters and go to work knowing this rugged antenna is doing its job $119.95



SWAN ELECTRONICS

SWAN METERS

THESE WATTMETERS TELL YOU WHAT'S GOING ON. With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you.

● WM2000 IN-LINE WATTMETER WITH MUSCLE. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $69.95.

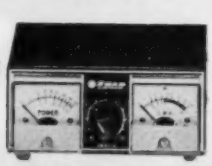
● WM3000 PEAK-READING WATTMETER. Reads RMS power, then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $87.95

● WM1500 HIGH-ACCURACY IN-LINE WATTMETER. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power. Use it for troubleshooting, too. $74.95

THE SWAN METER SHOWCASE.

Swim out radiated power wherever it is. This little unit is so compact it could measure relative radiated power in your pocket. Telescoping antenna and a frequency range of 1.5 MHz all the way to 200 MHz. **FS-1 Field Strength Meter** $13.95

Easy-on-the-pocket pocket SWR. Mighty mite SWR meter with high accuracy. SWR-1 gives you 1:1 to 3:1 SWR at 50 ohms on frequencies from 1.7 to 55 MHz. Precision PC board directional coupler makes it a solid value at a rock-bottom price. **SWR-1 Pocket SWR Meter** $14.95



Swill bridge bridges the price barrier. This little jewel gives you relative forward power and SWR on two 100 microampere meters at a remarkably low price. Indicates 1:1 to infinity VSWR of up to 1500-watt signals on frequencies from 3.5 to 150 MHz. With low insertion loss, it's great for mobile operations, too. **SWR-1A Power Meter and SWR Bridge** $89.95

At last. A precision wattmeter for the 6 and 2-meter man. We design the WM-6200 for the upper-band man who needs to know with ± 7% accuracy. Reads power of 50 to 150 MHz signals on two scales to 200 watts plus SWR on expanded range scale from 1:1 to 3:1 with ± accuracy. **WM-6200 In-Line Wattmeter ... $87.95**

Put your power up in lights. The new WMD-6200 does everything our WM-6200 does and ends guesswork, interpolation errors and eyestrain besides with a 4-digit readout, 50 to 150 MHz, power to 200 watts with an accuracy of ± 10%. SWR from 1:1 to 19.99:1 with ± 3% accuracy. **WMD-6200 Digital SWR Power Meter ... $269.95 (requires AC source)**

The new WM-200A does it all. As an in-line wattmeter it gives you power to 200 watts on two scales plus SWR from 1:1 to 3:1 for signals from 50 to 150 MHz. And as a peak reader it reads true peak envelope power of your voice modulated signal. Flat response forward or reflected power on scales to 200 watts in switch-selected 8MS or peak. **WM—200A Peak Reading Wattmeter ... $89.95**

Nifty little meter just for VHF mobile. This brand new, easy-to-install swivel-mount unit is the perfect illuminated wattmeter for 2-meter mobile. Compact and capable, it gives you two scales, 0-20 watts and 0-200 watts at 10% accuracy. SWR from 1:1 to 3:1. Frequencies from 50 to 150 MHz. **WMM-200 SWR Power Meter ... $49.95**

DenTron

MLA-2500 $899.50

DenTron Radio has packed all the features a linear amplifier should have into their new MLA-2500. Any Ham who works it can tell you the MLA-2500 really was built to make amateur radio more fun.

- ALC circuit to prevent overloading
- 160 thru 10 meters
- 1000 watts DC input on CW, RTTY or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external anode ceramic/metal triodes operating in grounded grid
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built-in RF wattmeter
- 117V or 234V AC 50-60 hz
- Third order distortion down at least 30 db
- Frequency range: 1.8MHz (1.8-2.5) 3.5MHz (3.4-4.6) 7MHz (6.0-9.0) 14MHz (11.0-16.0) 21MHz (16.0-22.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (19" rack)
- Size: 5½" H x 14" W x 14" D Wt. 47 lbs.

BOMAR Crystal Company

TWO METERS

CRYSTALS IN STOCK

Novice Crystals (Specify Band Only)

Motorola HT 220 Crystals In Stock!

Standard ● Icom ● Heathkit ● Ken ● Clegg ● Regency ● Wilson ● VHF Eng ● Drake ● And Others!

LIFETIME GUARANTEE! NOW ONLY $7.00 A PAIR!

Make/Model	Xmit Freq.	Rec. Freq.

PROGRAMMABLE CMOS KEYER

AUTEK RESEARCH

CALLS CQ WHILE YOU RELAX!

Also remembers name, QTH, contest exchanges, etc

MODEL MK-1

ONLY $99.50

- 4 Messages
- Instant record or reprogram
- Designed for Novice, as well as CW "Pro" and Contest OP

An Advanced Programmable Keyer - Yet Priced Lower Than Many Ordinary Keyers

Programmable memory keyers are the biggest advance to come along in years for CW. When you use one, CW truly becomes FUN again! Until the MK-1, quality memory keyers cost $150 to $400. But now, anyone can afford a "miniature computer," instead of an ordinary keyer. It's an investment in enjoyable operation for years to come. And an incredible bargain at our breakthrough low price!

ADVANCED "MOS" MEMORY

- Just tap button to start any of four messages.
- You record CQ, contest exchanges, name, QTH, or anything you want in the four messages.
- Record instantly by simply sending the message.
- Play out recording as often as desired.
- Change by simply recording over the old message. No factory-programmed extra cost IC's to buy.
- Large 1024 bit total memory stores about 100 characters. Each message holds about 25 characters, depending on character length and pauses, e.g., "CQ CQ DE W6OYD W6OYD CQ TEST K"
- "Combine C/D" switch combines 2 of the 4 messages for extra length of about 50 characters, e.g., "QTH IS LA LA NAME IS BILL BILL RIG HR IS KW ES BEAM ES NEW MEMORY KEYER"
- REPEAT SWITCH repeats message forever until reset. Very useful for longer CQ's, or leave a moderate pause at end of CQ. If no answer, the keyer automatically repeats the CQ until answered. YOU SIT BACK AND WAIT FOR A CALL!
- ADDED CONTEST FEATURES: Instant memory reset with button, or by tapping paddle when playing. Tapping message button restarts message.

PLUS A GREAT AUTOMATIC KEYER

- Dot AND dash memories "forgive" your minor timing mistakes. Most keyers have just a dot memory or none at all. The MK-1 makes sending easier.
- IAMBIC OPERATION. Squeezing dot and dash paddles produces alternate dots and dashes, making it easier to send letters such as C,F,K,Q,R, etc. Most keyers put out only dots, or only dashes when paddles are squeezed, making you work harder.
- FULL CMOS construction. No TTL logic to heat up or draw heavy current. Battery operation if desired. (50 ma. @ 9V., 60 ma. @ 12 V., typical)
- SELF-COMPLETING characters. Jamproof.
- Extensive RFI protection. 8-50+ WPM.
- Silent transistor output. No clicking relays to fail. (Max. ±300 V., .15 ma. grid blocked rigs, +200 ma. cathode keyed rigs; or key)
- TRIGGERED CLOCK (except when recording) starts instantly at key closure. No confusing wait, or need for you to "keep time," as with many keyers.
- Built-in monitor/speaker. Volume control (panel). Widely adjustable tone (internal trimpot).

To prevent loss of recorded messages when AC power is lost, a 9 V. battery may be connected to the rear battery input. No power is drawn from a battery if AC power is on. This makes the MK-1 ideal for field day or expeditions. The MK-1 may be left on continuously in fixed stations, if desired. (Draws less than 1.5 watts AC). The MK-1 may be used with any paddle. A dual-lever (squeeze) paddle is recommended to take advantage of iambic operation, but a single-lever paddle will also work.

115 VAC or 9-14 VDC. 8x7½x3". 2.5 lbs. Handsome light-grey panel with other lettering. Black steel case. Comes assembled and tested with full instructions.

VISTA power supplies

quality power conversion products for car, boat, home, trailer, truck or recreation vehicle

deluxe regulated R series

convert 120 vac, 60 Hz to 13.8 vdc ± 0.5 vdc

The VISTA series of regulated models is of the highest quality, utilizing the latest in integrated circuit (IC) technology, designed for long life and superior performance with hum-free, highly regulated stabilized output voltage . . . the standard of the industry.

models		applications
VISTA IIR*. . .2 amps continuous, 4 amps surge auto-reset breaker. UL listed, case size 3"xH x5Wx5D inches.	$29.95	Home use of low power mobile AM-CB radios, quality car tape players, trickle battery charging.
VISTA IIR . . .3 amps continuous, 5 amps surge auto-reset breaker. UL listed, case size 3"xH x5Wx5D inches.	$33.95	Home use of high power mobile AM-CB radios, quality car tape players, trickle battery charging.
VISTA IVR . . .4 amps continuous, 6 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 3"xH x5"xW x7"xD inches.	$43.95	Home use of mobile single side band CB, high power AM-CB and small ham radios, quality car tape players, tape recorders.
VISTA VIR . . .6 amps continuous, 8 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 3"xH x5"xW x7"xD inches.	$51.95	Home use of single side band CB radios, high power car stereo, for the HiFi perfectionist, low power 2 meter ham radios.
VISTA XR . . .8 amps continuous, 11 amps surge current limited, crowbar over-voltage protected, fused. UL listed features, case size 4"xH x6"xW x8"D inches.	$79.95	10 watts, 2 meter ham, FM-CB, marine and business band radios, low power linear amplifiers.
VISTA XRD . . .10 amps continuous, 13 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 4"xH x6"xW x8D inches.	$94.95	25 watts, 2 meter ham, FM-CB, marine and business band radios, low power linear amplifiers.
VISTA XXR . . .16 amps continuous, 20 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 4"xH x6"xW x8D inches.	$103.95	50 watts, 2 meter ham and FM-CB band radios, linear amplifiers.
VISTA XXRD . . .20 amps continuous, 25 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 4"xH x8Wx12"xD inches.	$139.95	50 and 75 watts, 2 meter ham band linear amplifiers test bench power supply.
VISTA XXXR . . .30 amps continuous, 40 amps surge current limiting, crowbar over-voltage protected, fused. UL listed features, case size 4"xH x8Wx14"xD inches.	$164.95	100 and 160 watts, 2 meter ham band linear amplifiers, test bench power supply.

*Output 12.5 VDC ± 0.5 VDC.

GIANT SALE NOW IN PROGRESS!

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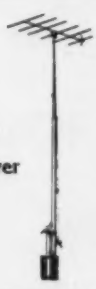


The only completely free-standing, telescoping, breakover tower you can buy.

The only completely free-standing, telescoping, breakover tower you can buy.

They telescope. Crank up or down easily to pinpoint best reception.

They breakover. Your feet never have to leave the ground when you pull maintenance — even on our tallest breakover tower.

One-piece price. You get the whole tower, ready to install. No extra charges for base plates, guy wire, etc.

Old-fashioned craftsmanship. Every Tele-Tow'r is cut, assembled, and welded by hand.

Old-fashioned value. Orville Bond found a way to make better towers for less money. Our model 40, which we believe is the most durable, convenient non-breakover 40-footer you can buy, is $224.21. Our Breakover Model 55, the *only* tower you can buy that is totally free-standing, telescoping, and a breakover, is just under $500.

Completely free-standing. No guy wires, no brackets. Yet, by stretching the windload over the entire tower, we've made them stronger than wired or bracketed towers.

55 Concrete Sleeve	$32.00
40 Concrete Sleeve	$32.50
Model 40 (extends from 23'-40')	$224.21
Model 55 (extends from 23'-55')	$410.16
Breakover Model 40 (extends from 23'-40', with breakover at ground level)	$381.30
Breakover Model 55 (extends from 23'-55', with breakover at ground level)	$572.65

TELE TOWR

CDE

Two NEW Rotors from Cornell-Dubilier

TAIL TWISTER™

HAM III

- For the New Super Communications Antennas
- New Thickwall Casting
- New Steel Ring Gear
- New Metal Pinion Gear
- New Motor Prebrake
- New Super Wedge Brake
- New L.E.D. Control Box
- Safe 26 Volt Operation

Designed for the newest of the king-size communications antennas, the TAIL TWISTER™ is the ultimate in antenna rotational devices. The TAIL TWISTER™ starts with a deluxe control box featuring snap action controls for brake and directional controls; L.E.D. indicators signal rotation and brake operation, while the illuminated meter provides direction readout. This new control box couples to the newest bell rotor. Using the time tested bell rotor principle, the TAIL TWISTER™ is a brand new design with thickwall castings and six bolt assembly. A brand new motor with prebrake action brings the antenna system to an easy stop, while the massive square front brake wedge locks the assembly in place. A new stainless steel spur gear system provides final drive into a new steel ring gear for total reliability. Triple race, 138 ball bearing assembly carries dead weight and maintains horizontal stability.

An optional heavy duty lower mast adaptor is available for lighter loads with mast mounting. Price: $259.00

The HAM III sets new levels of performance. Snap action switched wedge brake and rotational controls brings pinpoint accuracy to large directional arrays popular in communications. A new motor provides pre-brake action to assist in slowing down rotational mass, and the new thicker wedge brake offers far stronger lock-in phase action. To take full advantage of this new design, the HAM III is designed for in-tower mounting. A new optional heavy duty lower mast adaptor is available when the HAM III is to be mast mounted with smaller arrays. A stainless steel spur gear system multiplies the torque into the dual race 98 ball bearing support assembly assuring years of trouble free performance. Price: $139.00.

TUFTS RADIO CATALOG TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIO

FINCO STINGER VHF/UHF Antennas

2 meter

Stinger A 2-10—$41.15

The model Stinger A 2-10 is a high performance wide spaced ten-element 2-meter yagi designed for the serious VHF operator. Utilizing the Stinger construction features, the A 2-10 is almost indestructible no matter what weather conditions are encountered. Complete coverage of the 2-meter band and low V.S.W.R. is assured through the use of non-linear spaced elements thus also achieving maximum forward gain. Power rating – 2,000 watts P.E.P.
The A 2-10 can be mounted for vertical polarization, there by making the antenna quite useful in repeater scanning, or mounted for horizontal polarization for station to station VHF DX work. Additional boys of the A 2-10 can be easily stacked for even greater gain and front-to-back ratio.

SPECIFICATIONS – A 2-10

ELECTRICAL–		MECHANICAL–	
Forward Gain	13.8dB	Boom Length	10 ft.
Front-to-Back Ratio	25dB	Longest Element	42 in.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	71 in.
Half Power Beam Width	40°	Maximum Surface Area	2.36 sq. ft.
Bandwidth	144 to 148 MHz	Wind Load at 80 MPH	26.2 lbs.
Impedance	50 Ohms	Weight	9.6 lbs.
Matching System	Adjustable Gamma		

Stinger A 2-5—$25.60

The model Stinger A 2-5 is a five-element high gain antenna similar to the A 2-10 but having physically less of a profile. The A 2-5 finds excellent application as a portable antenna as it disassembles into a very compact package. Like the A 2-10, the antenna can be mounted for vertical or horizontal polarization for repeater or general coverage work. Constructed of the Stinger heavy duty materials, the A 2-5 is rated for long term encountering adverse weather conditions. Power rating 2,000 watts P.E.P.

SPECIFICATIONS – A 2-5

ELECTRICAL–		MECHANICAL–	
Forward Gain	9.5dB	Boom Length	9.5 ft.
Front-to-Back Ratio	22dB	Longest Element	41 in.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	42 in.
Half Power Beam Width	51°	Maximum Surface Area	1.23 sq. ft.
Bandwidth	144 to 148 MHz	Wind Load at 80 MPH	13.3 lbs.
Impedance	50 Ohms	Weight	6.5 lbs.
Matching System	Adjustable Gamma		

Stinger A 2+2—$41.75

The model Stinger A 2+2 is a ten-element, dual polarization 2-meter antenna designed for OSCAR communications or where switching from horizontal to vertical polarization is required. The A 2+2 can even be phased to operate on both horizontal and vertical polarization at the same time. This is not only ideal for OSCAR work but gives your station versatility for ground communications.
Wide, non-linear element spacing gives the A 2+2 superior gain, however, since it is a five element beam in one given plane, the half power beam width does not make satellite tracking difficult because of sharp directivity. The dual gamma match assemblies provide for a very low V.S.W.R. and will withstand 2,000 watts P.E.P.
The Stinger construction features make the A 2+2 extremely heavy duty. Provisions are made for mounting the antenna at the end of the boom – for azimuth control – or at the middle of the boom for normal applications.

SPECIFICATIONS – A 2+2

ELECTRICAL–		MECHANICAL–	
Forward Gain	9.5dB	Boom Length	8 ft.
Circular Gain	10.5dB	Longest Element	41 in.
Front-to-Back Ratio	22dB	Turning Radius–	
Half Power Beam Width		End Mount	5.5 ft.
Horizontal Polarization–		Center Mount	3.4 ft.
E Plane 67° H Plane	68°	Maximum Surface Area	1.51 sq. ft.
Vertical Polarization–		Wind Load at 80 MPH	13.4 lbs.
E Plane 68° H Plane	62°	Weight	11 lbs.
Circular Polarization–			
E Plane 67° H Plane	52°		
Bandwidth	144 to 148 MHz		
Impedence	50 Ohms		
Matching System	Adjustable Gamma		

1¼ meter

Stinger A 1¼—$29.65

The model Stinger A 1 1/4 is a ten element 1 1/4-meter (220 MHz) high performance yagi designed for all 220 MHz communication needs. Designed to be mounted in either the vertical or horizontal plane, the A 1 1/4 is adaptable for OSCAR, repeater, or general communication work. Incorporating the Stinger heavy duty elements, boom and beam to mast assemblies, the antenna easily withstands 120 mph wind loads under 1/4" ice conditions. A low loss gamma matching system assures a low V.S.W.R. and is power rated at 1,000 watts.

SPECIFICATIONS – A 1 1/4

ELECTRICAL–		MECHANICAL–	
Forward Gain	13.8dB	Boom Length	8 ft.
Front-to-Back Ratio	25dB	Longest Element	26 in.
V.S.W.R. (at resonance)	1.2:1	Turning Radius	4.3 ft.
Half Power Beam Width	40°	Maximum Surface Area	1.32 sq. ft.
Bandwidth	220 to 226 MHz	Wind Load at 80 MPH	17.9 lbs.
Impedence	50 Ohms	Weight	8 lbs.
Matching System	Adjustable Gamma		

10 meter

Stinger A 10-4—$57.15

The model Stinger A 10-4 is a wide spaced, full size, high gain four element 10-meter monoband designed for optimum DX performance. Utilizing the exclusive Stinger Series square boom construction, the A 10-4 is light enough to be easily stacked for an additional 3 dB gain yet strong enough to withstand the most adverse weather conditions. The highly efficient gamma match system easily withstands 2,000 watts P.E.P. of power and maintains a relatively low V.S.W.R. across the entire 10-meter amateur band.

SPECIFICATIONS – A 10-4

ELECTRICAL–		MECHANICAL–	
Forward Gain	10dB	Boom Length	16 ft.
Front-to-Back Ratio	25dB	Longest Element	16.2 ft.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	7.4 ft.
Half Power Beam Width	55°	Maximum Surface Area	4.4 sq. ft.
Bandwidth	28 to 30 MHz	Wind Load at 80 MPH	118 lbs.
Impedance	50 Ohms	Weight	12.5 lbs.
Matching System	Adjustable Gamma		

6 meter

Stinger A 6-5—$41.95

The model Stinger A6-5 is a highly directional 6-meter five element beam specifically designed for maximum forward gain with a "no compromise" front to back ratio. The elements are constructed of high tensile strength seamless aluminum tubing plus the exclusive Stinger square boom and bracket assemblies. For maximum power transfer and low V.S.W.R., a carefully designed gamma matching assembly capable of withstanding 2,000 watts P.E.P. is incorporated. Wide element spacing assures optimum DX performance and good operating efficiency across the entire 50 to 54 MHz 6-meter band. The square boom allows optional vertical mounting for accessing 6-meter repeaters.

SPECIFICATIONS – A 6-5

ELECTRICAL–		MECHANICAL–	
Forward Gain	11dB	Boom Length	13 ft.
Front-to-Back Ratio	25dB	Longest Element	10 ft.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	8.3 ft.
Half Power Beam Width	62°	Maximum Surface Area	3.23 sq. ft.
Bandwidth	50 to 54 MHz	Wind Load at 80 MPH	40.2 lbs.
Impedance	50 Ohms	Weight	11.5 lbs.
Matching System	Adjustable Gamma		

Stinger A 6-3—$27.30

The model Stinger A 6-3 is a 3-element high gain 6-meter beam similar to the A 6-5 but expressly designed for the casual 6-meter enthusiast. The A 6-3 also finds excellent application for portable use as it disassembles into a compact package. Due to the units light weight and minimal wind load, the antenna is ideal for double stacked and quad stacked arrays for the real 6-meter DXer. The A 6-3 is rated at 2,000 watts P.E.P. and incorporates a square boom and high tensile strength aluminum elements.

SPECIFICATIONS – A 6-3

ELECTRICAL–		MECHANICAL–	
Forward Gain	7.0dB	Boom Length	6.0 ft.
Front-to-Back Ratio	21.0dB	Longest Element	10 ft.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	5.4 ft.
Half Power Beam Width	80°	Maximum Surface Area	1.75 sq. ft.
Bandwidth	50 to 54 MHz	Wind Load at 80 MPH	17.6 lbs.
Impedance	50 Ohms	Weight	7 lbs.
Matching System	Adjustable Gamma		

6 and 2 meter

Stinger A 62—$68.60

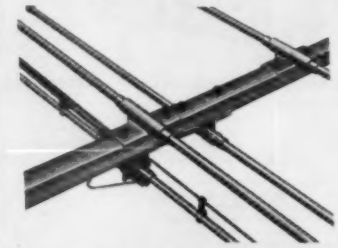
The model Stinger A 62 is a truly remarkable combination 6 and 2-meter beam designed for optimum performance on both bands yet only requiring ONE transmission line. This is accomplished through the use of exclusive phasing elements to accomplish dual band operation with no sacrifice to either band – NO SWITCHING REQUIRED!
On 2-meters, the A 62 has 6 collinear elements – equivalent to three 1/2 λ 6-element yagis stacked side by side – thus giving outstanding performance. Maximum forward gain is assured on 6-meters through the use of four wide spaced elements. The heavy duty Stinger construction is used throughout so that the antenna will withstand 100 mph plus wind loads.
The A 62 is ideal for mounting on the same mast as your tri-bander or other antenna thus easily opening up the world of 6 and 2-meter VHF communication.

SPECIFICATIONS – A 62

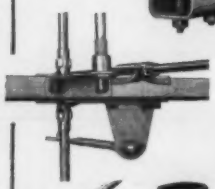
ELECTRICAL–		MECHANICAL–	
Forward Gain	6 meters 9.5dB	Boom Length	10.1 ft.
	2 meters 12.0dB	Longest Element	10 ft.
Front-to-Back Ratio	6 meters 19dB	Turning Radius	6.7 ft.
	2 meters 22dB	Maximum Surface Area	4.48 sq. ft.
V.S.W.R. (6 & 2 meters)	1.1:1	Wind Load at 80 MPH	43 lbs.
Half Power Beam Width	40° to 55°	Weight	13.8 lbs.
Bandwidth	6 meters 50 to 54 MHz		
	2 meters 144 to 148 MHz		
Impedence	50 ohms		
Matching System	Adjustable Gamma		

ENGINEERING FEATURES

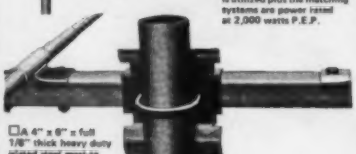
☐Antenna design engineering is a specialty at FINCO. Top quality lab standard test equipment is used throughout the development and design of all antennas. The FINCO antenna test range has been carefully checked for erroneous reflection characteristics that could cause errors in antenna designs. Shown is the sophisticated stub and matching system that has been developed for the Stinger A62, 6 and 2-meter dual band beam. No traps or coils to burn out or detune, thus assuring you of the highest possible performance on both 6 and 2-meters.



☐Exclusive Stinger square boom construction is used on all amateur antennas. The 1 ½" square booms are of .064 wall high tensile strength aluminum which is many times stronger than its round counter part. Also, special bracket assemblies have been developed to allow instant element to boom alignment – plus they stay aligned in the highest wind and ice loads. All elements are of thick wall high tensile strength aircraft quality aluminum.



☐All Stinger Series Amateur Antennas incorporate heavy duty fully adjustable gamma matching systems to allow for maximum power transfer. The design provides for minimum V.S.W.R. and a wide bandwidth. A built in SO-239 type connector assembly is utilized plus the matching systems are power rated at 2,000 watts P.E.P.



☐A 4" x 6" x full 1/8" thick heavy duty plated steel mast to boom mounting assembly is used on all Stinger Series of Amateur antennas. The bracket assembly locks permanently on the square boom and thus withstands high wind loads and torque without twisting or becoming misaligned. The assembly accepts mast diameters of up to 2" O.D. Provisions for mounting either in a vertical or horizontal plane is incorporated in several models.

ROHN NO. 25G TOWER & ACCESSORIES

SB25G 3'4" SHORT BASE section for concrete – $17.90
S8h25G* 3'4" HINGED SHORT BASE section for concrete – $29.15
HGB25G* 3' HINGED GROUND BASE (use without concrete) – $56.35
SDB25G* SINGLE DRIVE-IN BASE – $25.00
BPH25G* HINGED BASE PLATE for concrete – $50.00
FR25G* FLAT ROOF MOUNT – $34.10
PR25G* PEAK ROOF MOUNT – 26.25
*Note: Towers mounted on these bases must be bracketed or guyed.
RP25G ROTOR POST – $4.40

AS25G ACCESSORY SHELF (for mounting Ham-M rotor) – $8.35
GA25G GUY ASSEMBLY with torque bars – $15.85
GB25G GUY BRACKET ONLY without torque bars – $10.00
Adjustable House Brackets
HB25AG 0-15" – $14.15
HB25BG 0-24" – $17.50
HB25CG 0-36" – $20.85
Eave Brackets
EB2515G 15" – $8.35
EB2524G 24" – $9.15
EB2525G UNIVERSAL EAVE BRACKET – $10.00
TB-2 THRUST BEARING – $41.65
TB-3 HEAVY DUTY THRUST BEARING – $58.35
WP25G WORK PLATFORM – $24.60
Side Arm
SA25G-224 – $45.70
SA25G-524 – $45.70
24" SIDE ARM
SAB25G-2 – $28.90
SIDE ARM BRACKET – $28.90
SA25G-67 67" SIDE ARM – $45.70
UHF25G SIDE ARM MOUNT (for UHF & FM antenna) – $6.65
BPC25G* CONCRETE BASE PLATE – $29.60
25G – (10' straight section of tower) – $49.50
25AG-3 – (top section 2¼" tube type; 2" mast fits snugly inside) – $55.00
25AG-4 – (top section, upper end terminates in 11" flat plate for mounting TB-2 or TB-3 thrust bearing) – $55.00
3/8" TBE&J – (turnbuckles 3/8" x 6" 6,000 lbs ultimate strength) – $8.45 each.
3/16" CCM – cable clamps – 45¢ ea.
1/4" TH – thimbles – 30¢ ea.
1/2" TBE&J – (½" x 12" turnbuckles; 11,000 lbs. ultimate strength) – $14.35 each.
3/16" EHS – Guy wire:
250' – $27.50
500' – $55.00
1000' – $110.00
GAC-25-3 – concrete guy anchor – $16.65 each

(NOT UPS SHIPPABLE)

TELEX PROFESSIONAL HEADPHONES & HEADSETS

BOOM MIC HEADSETS

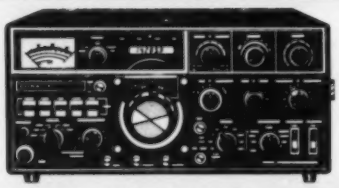
For the ultimate in communications convenience and efficiency select a boom mic headset. Long-time favorites of professional communications, boom mic headsets allow more personal mobility while always keeping the mic properly positioned for fast, precise voice transmission. Boom microphones are completely adjustable to allow perfect positioning. And, boom mic headsets leave both hands free to perform other tasks.

All models are supplied with "close talking" microphones to limit ambient noise pick up and provide superior intelligibility. Each model has a convenient, inline push-to-talk switch, which can be wired for either push-to-talk relay control or mic circuit interrupt for voice operated transmitters. The switch may be used as a momentary push button or it can be locked in the down position. All models have tough, flexible, 8 foot cords which are stranded and tinned, unterminated. Communication grey with black trim.

MODEL	C-610	SWL-610	C-1210	C-1320	CM-610	CM-1210	CM-1320	CM-1320S
Headphone Sensitivity Ref. 0002 Dynes/cm² @1mW input, 1kHz	103dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	105dB SPL ±5dB
Headphone Impedance	32 ohms	2000 ohms	32 ohms	32 ohms	32 ohms	32 ohms	32 ohms	32 ohms
Microphone Frequency Response					50 8000 Hz	50 8000 Hz	50 8000 Hz	50 8000 Hz
Microphone Impedance					High	High	High	High
Microphone Sensitivity Below 1 volt/microbar at 1kHz					-51dB ±5dB	-51dB ±5dB	-51dB ±5dB	51dB ±5dB
Price:	$9.95	$11.65	$28.30	$37.90	$42.80	$56.90	$68.30	$54.50

Model C610 (SWL 610) — Model C 1320 — Model CM 610 — Model C 1210

Model CM 1210 — Model CM 1320 — Model CM 1320S



The NEW KENWOOD TS-820S transceiver

TS-820S now has factory installed digital readout ● 160 thru 10 meter coverage ● 200 watts PEP ● Integral IF shift ● Noise blanker ● VOX & PLL circuitry ● DRS dial ● IF out, RTTY, XVTR capabilities ● Phone patch IN and OUT terminals ● RF speech processor. $1098.00.

the indispensable BIRD 43 THRULINE WATTMETER

Power Range	Frequency Bands (MHz) 3-30	25-60	100-250	200-500	400-1000
5 watts	–	5A	5C	5D	5E
10 watts	–	10A	10C	10D	10E
25 watts	–	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL 43	$125.00
Elements (Table 1) 2-30 MHz	45.00
Elements (Table 1) 25-1000 MHz	38.00
Carrying case for Model 43 & 6 elements	27.50
Carrying case for 12 elements	17.00

READ RF WATTS DIRECTLY! (Specify Type N or SO239 connectors) 0.45 – 2300 MHz, 1-10,000 Watts ±5%, low insertion VSWR – 1.05. Unequalled economy and flexibility. Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

Now you can receive the weak signals with the Ameco PT-2 pre-amplifier!

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one. Price: $69.95.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Simple to install. • Advanced solid-state circuitry.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

AMECO

ALL BAND PREAMPLIFIERS

AMECO

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp. Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

KENWOOD PRICE LIST

Model	Description	Price
HF EQUIPMENT 820 PACESETTER SERIES		
TS-820S	TS-820 Deluxe Transceiver with Digital Display (DG-1) installed. 160-10 meters, IF shift	1,098.00
TS-820	Deluxe HF Transceiver 160-10 meters, RF speech processor, IF shift, RF negative feedback	919.00
DG-1	Digital Frequency Display for TS-820	179.00
VFO-820	Deluxe Remote VFO for 820 Series. Includes its own RIT circuit; frequency reads out on transceiver's digital display	149.00
SP-820	Deluxe External Speaker. Includes audio filters for added versatility on receive; 2 audio inputs	49.00
CW-820	500 Hz CW Filter for TS-820	49.00
520 SERIES		
TS-520S	160-10 HF Transceiver. Digital Display (option) speech processor, RF attenuator, super noise blanker	739.00
DG-5	Digital Display for TS-520S. Doubles as a frequency counter, too! Adaptable to TS-520 and 599 series	189.00
VFO-520S	Remote VFO for TS-520S. Built in RIT circuit provides super operating flexibility	135.00
SP-520	Matching External Speaker for TS-520S. 8 Ohms. Frequency response 100-5000 Hz	30.00
CW-520	500 Hz CW Filter for TS-520	49.00
599D Series		
R-599D	160-10 Solod State Amateur Receiver. 2 and 6 meters (optional). SSB, CW, AM, FM Transceives/splits with T-599D	549.00
T-599D	80-10 Meter Amateur Transmitter. Solid State (except driver and finals). Semi break-in, sidetone, built in power supply	549.00
S-599	External Speaker for 599 Series. 8 Ohms. Frequency response: 100-5000 Hz	25.00
CC-29A	2 Meter Converter for R-599D	35.00
CC-69A	6 Meter Converter for R-599D	35.00
FM-599A	FM Filter for R-599D	45.00
HF MISCELLANEOUS		
R-300	All Band Communications Receiver. 170 kHz to 30 MHz – 6 bands, AC/DC/Batteries; built in speaker	249.00
AT-200	Antenna Tuner. Includes an tenna coupler, SWR meter, power meter, antenna switch, 200W	149.00
TL-922	Deluxe 160-10 Linear Amplifier. 2 KW PEP 2 x 3-500Z tubes, rugged built in power supply	TBA
DK-520	Digital Adaptor Kit (TS-520)	
DS-1A	DC-DC Converter for TS-820/TS-520S Series	65.00
VHF/UHF EQUIPMENT		
TS-600	6 Meter All Mode Transceiver. SSB, CW, FM, AM, 10 watts. Built in AC/DC power supplies	699.00
TS-700S	2 Meter All Mode Transceiver. SSB, CW, FM, AM, semi break-in, CW sidetone. Digital readout, receiver pre-amp	729.00
VFO-700S	External VFO for TS-700S. Frequency displays on TS-700S. Special "frequency check" feature	129.00
SP-70	8 Ohms External Speaker Matches TS-600 and TS-700S. Excellent frequency response	30.00
TR-2200A	2 Meter Portable Transceiver. FM, 12 channels (6 supplied); NI-CAD batteries, charger are included	229.00
TR-7400A	2 Meter Synthesized Transceiver. 25 Watts, 800 channels, 4 MHz, continuous tone-coded squelch (option)	399.00
TR-7500	2 Meter FM Transceiver; digital readout, one knob channel selector system, 10 watts output	299.00
TR-8300	70 CM FM Transceiver. 23 channels (3 supplied). 10 watts, broadband design	299.00
TV-502S	2 Meter Transverter, 8 watts; SSB and CW easily hooks up to 520/820 Series	TBA
TV-506	6 Meter Transverter, 10 watts; SSB and CW, easily hooks up to 520/820 Series	249.00
OTHER ACCESSORIES		
HS-4	KENWOOD Headphone set (8 Ohms)	16.00
MB-1A	Mobile bracket for TR-2200 A	13.00
MC-50	Dynamic Microphone for all KENWOOD stations (Hi/Lo Z)	39.50
PS-5	AC Power Supply; 12 VDC @ 3.5 Amps, matches TR-8300; built-in digital clock with timer	79.00
PS-6	AC Power Supply; 12 VDC @ 3.5 Amps; matches TR-7500; 8 Ohm speaker included	79.00
PS-8	AC Power Supply; 12 VDC @ 8 Amps; matches TR-7400A; well regulated; current limiting	129.00
VOX-3	VOX Unit for TS-700A and TS-600	25.00

TUFTS RADIO CATALOG TUFTS RADIO

GIANT FLEA MARKET!
THOUSANDS OF $$$$ IN PRIZES!
Don't Miss The N.E. ARRL Convention
Oct. 14th-15th
At The Beautiful Sheraton Boxborough
Boxborough, Mass.

GIANT FLEA MARKET!
THOUSANDS OF $$$$ IN PRIZES!
Don't Miss The N.E. ARRL Convention
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Boxborough, Mass.

ADD-ON POWER!

Highest quality, American-made "brand" transistors are fully protected for VSWR, short and overload, reverse polarity. Highly effective heat sinking assures long life, reliable performance. Black anodized containers...exclusive KLM extrusions, **have seven, full length fins on both sides!**

KLM RF Power Amplifiers

- A simple, add-on-immediately RF amplifier.
- Merely coax-connect amplifier between antenna and transceiver.
- No tuning! Efficient strip-line broad band design.
- Automatic! Internal RF-sensor-controlled relay connects amplifier whenever transmitter is switched on. Manual, remote-position switching is optional.
- Models for 6,2,1¼ meters, 70CM amateur bands plus MARS coverage.
- Two types: **Class C** for FM/CW. **Linear** for SSB/AM/FM/CW.
- Negligible insertion loss on receive.
- American made by KLM.

New Model	List Price		
PA 2-25B	$ 69.95	PA 4-70BC	189.95
PA 4-70BL	189.95	PA 15-60BC	164.95
PA 15-40BL	109.95	PA 45-120BC	209.95
PA 15-80BL	179.95	PA 4-40C	169.95
PA 15-160BL	259.95	PA 15-35CL	154.95
PA 45-140BL	219.95	PA 15-110CL	279.95

ATLAS 350-XL

- ALL SOLID STATE
- 350 WATTS P.E.P. OR CW INPUT
- SSB TRANSCEIVER
- 10 THROUGH 160 METER COVERAGE

Illustrated with optional AC supply, Auxiliary VFO, and Digital Dial.

The all new Atlas 350-XL has all the exciting new features you want, plus superior performance and selectivity control never before possible Price: $1195.00

- 10-160 Meters

Full coverage of all six amateur bands in 500 kHz segments. Primary frequency control provides highly stable operation. Also included is provision for adding up to 10 additional 500 kHz segments between 2 to 22 MHz by plugging in auxiliary crystals.

- 350 WATTS P.E.P. and CW input.
- Model 350 XL – $1195.00

IDEAL FOR DESKTOP OR MOBILE OPERATION

Measuring just 5 in. high x 12 in. wide x 12½ in. deep, and weighing only 13 pounds, the Atlas 350-XL offers more features, performance and value than any other transceiver, regardless of size, on the market today!

- 350-PS matching AC supply – $225.00
- DD-6XL plug-in digital dial readout – $229.00
- 305 plug-in auxiliary VFO – $155.00
- 311 plug-in crystal oscillator – $135.00
- DMK-XL plug-in mobile mounting kit – $65.00

TEMPO VHF/ONE PLUS

The Tempo/ONE PLUS offers full 25 watt output or a selectable 3 to 15 watt low power output, remote tuning on the microphone, sideband operation with the SSB/ONE adapter, MARS operation capability, 5 kHz numerical LED, and all at a lower price than its time tested predecessor ... the Tempo VHF ONE.

The Tempo VHF/One Plus is a VHF/FM transceiver for dependable communication on the 2 meter amateur band ● Full 2 meter coverage, 144 to 148 MHz for both transmit and receive ● Full phase lock synthesized (PLL) ● Automatic repeater split – selectable up or down ● Two built-in programmable channels ● All solid state ● 800 selectable receive frequencies with simplex and +600 kHz transmit frequencies for each receive channel. Price: $399.00

DELUXE RECEIVER PREAMPLIFIERS

Ideal for Receivers – Converters
High Gain – Low Noise

FEATURES:
- Small size
- Increases sensitivity of most receivers
- Gold-plated copper shielding
- Single or double stage models
- Diode protected, dual-gated FETs

When ordering be sure to specify:
1. frequency of operation
2. single or double band stage
3. kit or assembled version

SPECIFICATIONS:
Power: 6 VDC to 18 VDC (12 VDC recommended)
Size: a. Single stage: 1" x 1⅜" x ½"
b. Double stage: 2" x 1⅜" x ½"
MOSFET: FT 0601, 500 MHz, dual-gate diode protected MOSFET

FREQ. (MHz)	USE	STAGES	DELUXE PREAMPLIFIER GAIN dB	NF dB	WIRED
50 to 54	6 METER	SINGLE	25	2	$16.50
		DOUBLE	48	2	$28.50
108 to 144	VHF AIRCRAFT	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
135 to 139	SATELLITE	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
144 to 148	2 METER	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
146 to 174	HIGH BAND	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
220 to 225	1¼ METER	SINGLE	18	2.5	$14.50
		DOUBLE	35	2.5	$26.50
225 to 300	UHF AIRCRAFT	SINGLE	15	2.5	$14.50
		DOUBLE	30	2.5	$26.50

DATA SIGNAL, INC.

THE BIG SIGNAL

UNADILLA "W2AU" BALUN

$14.95

*UNADILLA ORIGINATED!

- World Famous Among Hams Armed Forces, Communications Industry. Why?
- Each BALUN 2KW PEP tested
- Lightning Arrester
- 600-Ω Pull – No Insulator Needed
- Only 7 oz. and 6" x 1¼" diameter
- Reduces TVI
- Improves F-B ratios
- Weatherproof
- Complete Instructions
- Antenna Length Table

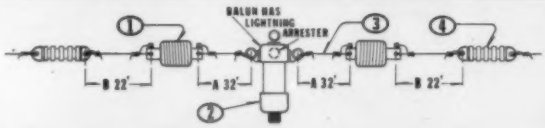
THE OLD RELIABLE

REYCO "W2VS" ANTENNA COILS

$21.95 pair

*FREQUENCY-MATCHED PAIRS!

- Turns Your Antenna Into A Multi-Band Professional Diamond Reyco! Why?
- Precision Machined
- Frequency-Matched Pairs
- Only 6 oz. and 5½" x 1¼" diameter
- Rugged – Over 300-# Pull
- Weatherproof
- Models for 10, 15, 20, 40 Meters
- Complete Instructions
- Multi-Band Length/Tuning Data



W2AU/W2VS ● 5 BAND 10/80 METER ANTENNA KIT by UNADILLA/REYCO

GIVES YOU OPERATION ON 10 ● 15 ● 20 ● 40 ● 80 METERS

(DESIGNED CLOSELY TO 5 BAND TRAP DIPOLE PARAMETERS PER A.R.R.L. HANDBOOK, HF ANTENNA CHAPTER 21 'A MULTIBAND TRAP ANTENNA')

Every Component of This Kit is a Highly Crafted, old Line UNADILLA/REYCO Product Time Tested by HAMS, COMMERCIAL & ARMED FORCES FACILITIES – AROUND THE WORLD – FOR OVER 10 YEARS!

COMPLETE KIT (Nothing else needed)

- 2 ea. W2VS REYCO KW-40 TRAPS
- 1 ea. W2AU 'BIG SIGNAL' BALUN 1:1
- 120 Ft. RUGGED #14-7 Strand Copper Wire
- 2 ea. W2AU SHATTERPROOF END-sulators
- INSTRUCTIONS
- $48.25

MICROWAVE FILTER COMPANY, INC.

TUFTS RADIO CATALOG TUFTS RADIO

14-16 Pin Dip IC Inserter	INS-1416	$3.49

DIP/IC EXTRACTOR TOOL

The EX-1 Extractor is ideally suited for hobbyist or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.

Extractor Tool	EX-1	$1.49

P.C. BOARD

The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector, with contacts on standard .156 spacing. Edge contacts are non-dedicated for maximum flexibility.

The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 8-40 pins, as well as discrete components. Typical density is 18 of 14-Pin or 16-Pin DIP's. Components may be soldered directly in the board or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual busses running the full length of the board for complete wiring flexibility. These busses enable access from edge contacts to discrete components. These busses can also serve to augment the voltage or ground busses, and may be cut to length for particular applications.

Hobby Board	H-PCB-1	$4.99

PC CARD GUIDES

TR-1 consists of 2 guides precision molded with unique spring finger action that dampens shock and vibration, yet permits smooth insertion or extraction. Guides accommodate any card thickness from .040 .100 inches.

QUANTITY – ONE PAIR (2 pcs.)

Card Guides	TR-1	$1.89

PC CARD GUIDES & BRACKETS

TRS-2 kit includes 2 TR 1 guides plus 2 mounting brackets. Support brackets feature unique stabilizing post that permits secure mounting with only 1 screw.

QUANTITY – ONE SET (4 pcs.)

Guides & Brackets	TRS-2	$3.79

QUANTITY – ONE SET (4 pcs.)

PC EDGE CONNECTOR

44 Pin, dual read out, .156" (3,96 mm) Contact Spacing, .025" (0,63 mm) square wire-wrapping pins.

P.C. Edge Connector	CON-1	$3.49

P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 16 30 AWG (1, 0.5, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

4-Pole	TS- 4	$1.39
8-Pole	TS- 8	$1.89
12-Pole	TS-12	$2.59

WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

Wire-Wrapping Kit	WK-40 (Blue)	$25.99

HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30	$5.95
Modified Wrap	WSU-30M	$7.95

WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	$34.95*
For AWG 26-28	BW-2628	$39.95*

Bit for AWG 30	BT-30	$3.95
Bit for AWG 26-28	BT-2628	$7.95

*USE "C" SIZE Hi-CAD BATTERIES (NOT INCLUDED)

ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire 50ft Roll	R 30B 0050	$1.98
30 AWG Yellow Wire 50ft Roll	R 30Y 0050	$1.98
30 AWG White Wire 50ft Roll	R 30W 0050	$1.98
30 AWG Red Wire 50ft Roll	R 30R 0050	$1.98

WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B	$3.95
Yellow Wire	WD-30-Y	$3.95
White Wire	WD-30-W	$3.95
Red Wire	WD-30-R	$3.95

PRE CUT PRE STRIPPED WIRE

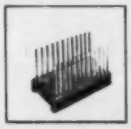
Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.

30 AWG Blue Wire 1" Long	30 B 50 010	$.99
30 AWG Yellow Wire 1" Long	30 Y 50 010	$.99
30 AWG White Wire 1" Long	30 W 50 010	$.99
30 AWG Red Wire 1" Long	30 R 50 010	$.99
30 AWG Blue Wire 2" Long	30 B 50 020	$1.09
30 AWG Yellow Wire 2" Long	30 Y 50 020	$1.09
30 AWG White Wire 2" Long	30 W 50 020	$1.09
30 AWG Red Wire 2" Long	30 R 50 020	$1.09
30 AWG Blue Wire 3" Long	30 B 50 030	$1.19
30 AWG Yellow Wire 3" Long	30 Y 50 030	$1.19
30 AWG White Wire 3" Long	30 W 50 030	$1.19
30 AWG Red Wire 3" Long	30 R 50 030	$1.19
30 AWG Blue Wire 4" Long	30 B 50 040	$1.29
30 AWG Yellow Wire 4" Long	30 Y 50 040	$1.29
30 AWG White Wire 4" Long	30 W 50 040	$1.29
30 AWG Red Wire 4" Long	30 R 50 040	$1.29
30 AWG Blue Wire 5" Long	30 B 50 050	$1.39
30 AWG Yellow Wire 5" Long	30 Y 50 050	$1.39
30 AWG White Wire 5" Long	30 W 50 050	$1.39
30 AWG Red Wire 5" Long	30 R 50 050	$1.39
30 AWG Blue Wire 6" Long	30 B 50 060	$1.49
30 AWG Yellow Wire 6" Long	30 Y 50 060	$1.49
30 AWG White Wire 6" Long	30 W 50 060	$1.49
30 AWG Red Wire 6" Long	30 R 50 060	$1.49

WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30, Roll of wire R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

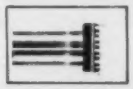
Wire-Wrapping Kit	WK-30 (Blue)	$16.95



DIP SOCKET

Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins .025 (0,63mm) sq., .100 (2,54mm) center spacing.

14 Pin Dip Socket	14 Dip	$0.79
16 Pin Dip Socket	16 Dip	$0.89



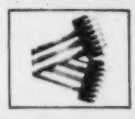
RIBBON CABLE ASSEMBLY SINGLE ENDED

With 14 Pin Dip Plug 24" Long (609mm)	SE14-24	$3.95
With 16 Pin Dip Plug 24" Long (609mm)	SE16-24	$3.75

DIP PLUG WITH COVER FOR USE WITH RIBBON CABLE

14 Pin Plug & Cover	14-PLG	$1.49
16 Pin Plug & Cover	16-PLG	$1.59

QUANTITY: 2 PLUGS, 2 COVERS



RIBBON CABLE ASSEMBLY DOUBLE ENDED

With 14 Pin Dip Plug -2" Long	DE 14-2	$3.75
With 14 Pin Dip Plug -4" Long	DE 14-4	$3.85
With 14 Pin Dip Plug -8" Long	DE 14-8	$3.95
With 16 Pin Dip Plug -2" Long	DE 16-2	$4.15
With 16 Pin Dip Plug -4" Long	DE 16-4	$4.25
With 16 Pin Dip Plug -8" Long	DE 16-8	$4.35

TERMINALS

- .025 (0,63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

Slotted Terminal	WWT-1	$2.98
Single Sided Terminal	WWT-2	$2.98
IC Socket Terminal	WWT-3	$3.98
Double Sided Terminal	WWT-4	$3.98

75 PER PACKAGE

TERMINAL INSERTING TOOL

For inserting WWT-1, WWT-2, WWT-3, and WWT-4 Terminals into .040 (1,01mm) Dia. Holes.

INS-1	$2.49	

WIRE CUT AND STRIP TOOL

Easy to operate ... place wires (up to 4) in stripping slot with ends extending beyond cutter blades ... press tool and pull wire is cut and stripped to proper "wire-wrapping" length. The hardened steel cutting blades and sturdy construction of the tool ensure long life.

Strip length easily adjustable for your applications.

DESCRIPTION	MODEL NUMBER	ADJUSTABLE STRIPPED LENGTH OF STRIPPED WIRE FROM	TO	Price
24 ga. Wire Cut and Strip Tool	ST-100-24	1/16"	1/4"	$ 8.75
26 ga. Wire Cut and Strip Tool	ST-100-26	1/16"	1/4"	$ 8.75
26 ga. Wire Cut and Strip Tool	ST-100-26-975	1/8"	1/4"	$ 8.75
28 ga. Wire Cut and Strip Tool	ST-100-28	1/8"	1/4"	$11.95
30 ga. Wire Cut and Strip Tool	ST-100-30	1/8"	1/4"	$11.95

THE ABOVE LIST OF CUT AND STRIP TOOLS ARE NOT APPLICABLE FOR MYCRO OR TOTUS OPERATION

WIRE-WRAPPING KITS

Contains: Hobby Wrap Tool WSU-30, (50 ft.) Roll of wire Prestripped wire 1" to 4" lengths (50 wires per package) stripped 1" both ends.

Wire Wrapping Kit (Blue)	WK 2 B	$12.95
Wire Wrapping Kit (Yellow)	WK 2 Y	$12.95
Wire Wrapping Kit (White)	WK 2 W	$12.95
Wire Wrapping Kit (Red)	WK 2 R	$12.95

HI-Q BALUN

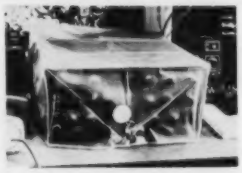
- For dipoles, yagis, inverted vees, doublets & quads
- For full legal power & more
- Puts power in antenna
- Broadbanded 3-40Mhz.
- Small, light, weather-proof
- 1:1 impedance ratio
- Replaces center insulator
- Helps eliminate TVI
- Fully Guaranteed

$9.95 PPD U.S.A.

Van Gorden Engineering

DUST COVERS

•Our covers are custom designed to protect all popular equipment models. •They are made of rugged high quality vinyl and are machine stitched for extra strength. •They add that professional look to your station. $3.95.



COVER CRAFT

CES Touch Tone Pads

- Model 300 – acoustic coupling. $49.95
- Model 210 – for mounting on walkies or hand-helds. $39.95
- Model 220 – CES can now offer you a TOUCH TONE back for Standard Communications hand-held radios. This is the complete back assembly with the TOUCH TONE encoder mounted and ready to plug into the private channel connector. Also included is a LED tone generator indicator and an external tone deviation adjustment. $59.95.
- Model 215 (miniature version of 210) – $39.95
- Model 221 long – $59.95
- Model 221 short – $59.95

} Motorola HT220 Back with Pad Mounted

TUFTS RADIO CATALOG TUFTS RADIO

ATB-34

cushcraft

4 ELEMENT BEAM 10-15-20 METERS

Cushcraft engineers have incorporated more than 30 years of design experience into the best 3 band HF beam available today. **ATB-34** has superb performance with three active elements on each band, the convenience of easy assembly and modest dimensions. Value through heavy duty all aluminum construction and a price complete with 1-1 balun.

SPECIFICATIONS

FORWARD GAIN -	EXCELLENT	LONGEST ELEMENT -	32'8"
F/B RATIO -	30 dB	TURNING RADIUS -	16'9"
VSWR -	1.5-1	WIND SFC -	5.4 Sq.Ft
POWER HANDLING -	2000 WATTS PEP	WEIGHT -	42 Lbs
BOOM LENGTH/DIA -	18' x 2 1/8"	WIND SURVIVAL -	90 MPH

$259.59 complete

UPS SHIPPABLE

ENJOY A NEW WORLD OF DX COMMUNICATIONS WITH ATB-34

VHF - UHF DX-ARRAYS
144, 220, 430 mhz

20 ELEMENT DX - ARRAYS

20 ELEMENT SPECIFICATIONS

Forward Gain ------ 14.2 db
F/B Ratio ---------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 48°
vertical ---------- 26°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	118"	78"	42"
Width x Depth	75" x 30"	53" x 20"	29" x 11"
Turning Radius	46"	32"	18"
Maximum Mast Dia.	1 1/2"	1 1/2"	1 1/2"
Net Weight Lbs.	9	7	6

Vertical support must not supplied

2 Meter DX-120	1¼ Meter DX-220	¼ Meter DX-420
Am. Net $47.95	$42.95	$36.95

40 ELEMENT DX - ARRAYS

40 ELEMENT SPECIFICATIONS

Forward Gain --------- 17 db
F/B Ratio ---------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 32°
vertical ---------- 26°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	118"	78"	42"
Width x Depth	193" x 30"	133" x 20"	72" x 11"
Turning Radius	101"	66"	36"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Net Weight Lbs.	32	22	12
Wind Rating	90 mph	90 mph	90 mph
Stack Kit No.	DKK-140	DKK-240	DKK-440
Amateur Net	$ 65.95	$59.95	$45.95

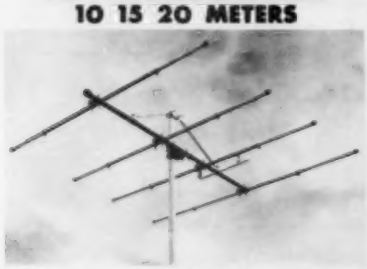
80 ELEMENT DX - ARRAYS

80 ELEMENT SPECIFICATIONS

Forward Gain --------- 20 db
F/B Ratio ---------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 32°
vertical ---------- 13°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	275"	142"	97"
Width x Depth	193" x 30"	133" x 20"	72" x 11"
Turning Radius	101"	65"	38"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Wind Rating	90 mph	90 mph	90 mph
Net Weight Lbs.	64	43	24
Stack Kit No.	DKK-180	DKK-280	DKK-480
Amateur Net	$119.95	$99.95	$89.95

HF MONOBEAMS
10 15 20 METERS



10 METERS

3 ELEMENT BEAM: You can have an outstanding signal using this compact three element beam. It is easily mounted on a lightweight rotator and takes only a limited amount of space.
Model No. A28-3—$79.95
4 ELEMENT BEAM: A real DX'ers beam for the active ham who wants a top signal on 10 meters. Mount on a good ham rotator. Model No. A28-4—$89.95

SPECIFICATIONS	A28-3	A28-4
BOOM	1 1/2" x 10'	1 5/8" x 16'
LONGEST ELEMENT	17' 6"	16'
ELEMENT DIAMETER	7/8" - 1/2"	7/8" - 3/4"
TURNING RADIUS	10'	14' 3"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	11 lbs.	21 lbs.

15 METERS

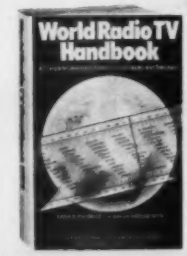
3 ELEMENT BEAM: A high quality beam which can be mounted on a mast with other antennas. A heavy duty TV rotator will handle it.
Model No. A21-3—$99.95
4 ELEMENT BEAM: For the 15 meter enthusiast this beam will give real DX performance. When mounted on a good ham rotator it will withstand the most adverse weather conditions.
Model No. A21-4—$129.95

SPECIFICATIONS	A21-3	A21-4
BOOM	1 5/8" x 12'	1 3/4" x 21' 6"
LONGEST ELEMENT	22' 10"	22' 10"
ELEMENT DIAMETER	7/8" - 3/4"	7/8" - 3/4"
TURNING RADIUS	13' - 3"	15' - 8"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	16 lbs.	32 lbs.

20 METERS

3 ELEMENT BEAM: Full size beam performance for the active 20 meter ham with limited space and budget.
Model No. A14-2—$119.95
3 ELEMENT BEAM: A real DX-er's beam with full .15 wavelength element spacing. The heavy duty construction gives years of trouble-free service. Model No. A14-3 $159.95

SPECIFICATIONS	A14-2	A14-3
BOOM	1 5/8" x 16'	1 5/8" x 20' 6"
LONGEST ELEMENT	35' 10"	35' 10"
ELEMENT DIAMETER	1 1/8" - 3/4"	1 1/8" - 3/4"
TURNING RADIUS	18'	21'
FORWARD GAIN	5 db	8 db
F/B RATIO	13 db	22 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	20 lbs.	35 lbs.



World Radio TV Handbook 1978

A Complete Directory of International Radio and Television

The most exhaustive and authoritative guide to broadcasting and television stations around the world today. **WORLD RADIO TV HANDBOOK 1978** is an indispensable manual for anyone with a working interest in radio and television. Features:

- Names and addresses of broadcast companies and stations by country
- Names and titles of leading officials and personnel
- Listing by frequency of shortwave stations around the world
- Program data including frequencies, wave lengths, transmitter power, call signs, times, announcements (in each language)

Plus, a special, in-depth editorial section with professional articles, suggestions and tips—and much, much more. **WORLD RADIO TV HANDBOOK 1978** is available now for only $11.95

HF Verticals 10-80 Meters

● efficient top ring ● fiberglass trap forms ● enameled wire coils ● solid aluminum capacitors ● no tuning required ● full compression clamps ● omnidirectional coverage ● reinforced base ● mast or ground mounting ● pre-marked sections ● easy assembly ● superior quality

3 BAND 20-15 meters/Model ATV-3 ..... $49.95
4 BAND 40-20-15-10 meters/ Model ATV-4 ..... $89.95
5 BAND 80-40-20-15-10 meters /Model ATV-5 ..... $109.95

cushcraft

Speak up.

We know all about up. In fact, we're number one from the ground up...when it comes to amateur communications towers. We've been building them for HAMS for more than two decades.

Whether you're thinking crank-up, guyed or free-standing, check with us first. We're Tri-Ex. Reliable, dependable.

When we say number one from the ground up, we're talking about towers like Tri-Ex's new "Big W" shown here. It's a free-standing crank-up with a height of 80-ft, providing good DX capability at low cost. Ideal for serious HAMS.

Model W51
(51' Self-supporting)
$850.00

Tri-Ex TOWER CORPORATION

SST T-1 RANDOM WIRE ANTENNA TUNER

All band operation (160-10 meters) with any random length of wire. 200 watt output power capability — will work with virtually any transceiver. Ideal for portable or home operation. Great for apartments and hotel rooms — simply run a wire inside, out a window, or anyplace available. Toroid inductor for small size: 4-1/4" x 2-3/8" x 3". Built-in neon tune-up indicator. SO-239 connector. Attractive bronze finished enclosure. Only $29.95

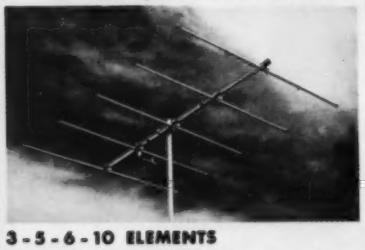
SST T-2 ULTRA TUNER

Tunes out SWR on any coax fed antenna as well as random wires. Works great on all bands (160-10 meters) with any transceiver running up to 200 watts power output. Increases usable bandwidth of any antenna. Tunes out SWR on mobile whips from inside your car.
Uses toroid inductor and specially made capacitors for small size: 5¼" x 2¼" x 2¼". Rugged, yet compact. Attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coax fed antennas. Convenient binding posts are provided for random wire and ground connections. Only $49.95

SST T-3 IMPEDANCE TRANSFORMER

Matches 52 ohm coax to the lower impedance of a mobile whip or vertical. 12 position switch with taps spread between 3 and 52 ohms. Broadband from 1-30 MHz. Will work with virtually any transceiver — 300 watt output power capability. SO-239 connectors. Toroid inductor for small size: 2-3/4" x 2" x 2-1/4." Attractive bronze finish. Only $19.95

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

COAXIAL DUAL STACKING KITS

Double your effective radiated power by stacking 6 meter beams. Cush Craft coaxial stacking kits provide a simple and efficient method for realizing 3 dB additional gain while maintaining the superior characteristics of our single beams. The stacking kits are complete with RG-59/U cable and preassembled fittings for direct 52 ohm feed.

Model No.	For stacking:	Amateur Net
A535-SK	A50-3 or A50-5	$17.95
A561-SK	A50-6 or A50-10	$19.95

new **RINGO RANGER** for **FM**

4.5 dB* – 6 dB Omnidirectional GAIN BASE STATION ANTENNAS FOR MAXIMUM PERFORMANCE AND VALUE**

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.27'	.09'	.10'

8-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 33' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.83 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (32 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-32 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK, complete 4 element stacking kit
A14-SK, 4 element coax harness only
A147-VPK, complete 11 element stacking kit
A147-SK, 11 element coax harness only
A449-SK, 8 + 11 element coax harness only

E-4-8-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-8	A220-11
Boom/Longest ele.	144"/40"	44"/40"	80"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.5/28	9/20	13.5/28	11/25	13.5/28
½ Power beam	48°	66°	48°	66°	48°
Wind area sq. ft.	1.21	.43	.39	.30	.50
Frequency MHz	144-148	144-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 136", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.62 sq. ft.

HIGH PERFORMANCE VHF YAGIS

3/4, 1-1/4, 2 METER BEAMS

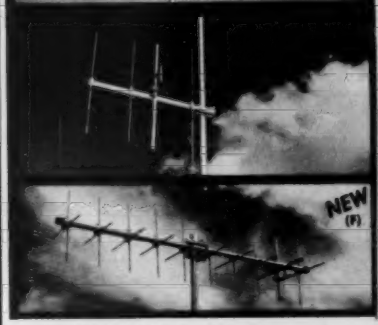
The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

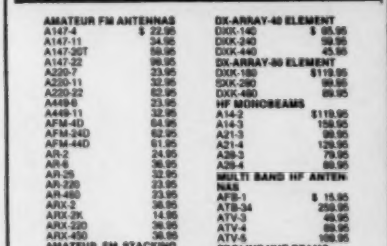
Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O.D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	96"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	26 dB	26 dB	26 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

cushcraft CORPORATION





AMATEUR FM ANTENNAS

A147-4	$ 22.95
A147-11	54.95
A147-20T	59.95
A147-22	99.95
A220-7	23.95
A220-11	32.95
A220-22	62.95
A449-8	23.95
A449-11	32.95
AFM-4D	64.95
AFM-24D	62.95
AFM-44D	61.95
AR-2	24.95
AR-6	36.95
AR-25	32.95
AR-220	23.95
AR-450	23.95
ARX-2	36.95
ARX-2K	14.95
ARX-220	36.95
ARX-450	36.95

AMATEUR FM STACKING KITS

A14-SK	$ 17.95
A14-VPK	28.95
A21-SK	17.95
A220-VPK	28.95
A147-SK	17.95
A147-VPK	32.95
A449-SK	17.95
A449-VPK	28.95

BIG WHEEL ANTENNAS

ASW-125	$ 17.95
ASW-145	27.95
ASW-144	36.95

BLITZ BUG

LAC-1	$ 4.95
LAC-2	4.95

DX ARRAYS-20 ELEMENT

DX-120	$ 47.95
DX-220	42.95
DX-420	39.95

DX-ARRAY BALUNS

DX-1BN	$ 14.95
DX-2BN	14.95
DX-4BN	14.95
DX-VPB	19.95

SQUALO ANTENNAS

ASQ-2	$ 19.95
ASQ-6	29.95
ASQ-22	42.95
ASQ-6BK	17.95
ASQ-M	17.95

DX-ARRAY-40 ELEMENT

DXK-140	$ 69.95
DXK-240	59.95
DXK-440	45.95

DX-ARRAY-80 ELEMENT

DXK-180	$119.95
DXK-280	99.95
DXK-480	69.95

HF MONOBEAMS

A14-2	$119.95
A14-3	159.95
A21-3	99.95
A21-4	129.95
A28-3	79.95
A28-4	89.95

MULTI BAND HF ANTENNAS

AFE-1	$ 15.95
ATB-34	259.95
ATV-3	49.95
ATV-4	69.95
ATV-5	109.95

PROLINE VHF BEAMS

APL-25X	$ 34.95
APL-45X	29.95
APL-45	159.95
APL-210	119.95

TWIST ANTENNAS

A147-MB	$ 17.95
A144-10T	39.95
A144-20T	59.95
A144-90QT	369.95
A432-20T	54.95

VHF/UHF BEAMS

A50-3	$ 39.95
A50-5	54.95
A50-6	79.95
A50-10	109.95
A144-7	23.95
A144-11	39.95
A430-11	27.95

VHF/UHF STACKING KITS

A11-SK	$ 17.95
A17-SK	17.95
A41-SK	17.95
A535-SK	17.95
A561-SK	19.95
AQK-144	69.95
AQK-444	79.95

MOBILE ANTENNAS

AMS-147	$ 34.95
ATB-147	32.95

TUFTS RADIO CATALOG — TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIC

For all you hams with little cars ...

We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

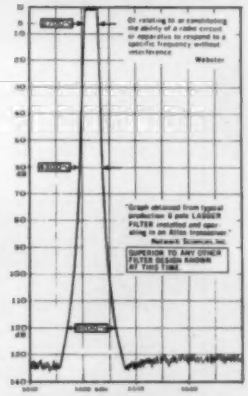
200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND CHVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.


Webster
"Graph obtained from typical production 8 pole LADDER FILTER installed and operating in an Atlas transceiver."
SUPERIOR TO ANY OTHER FILTER DESIGN KNOWN AT THIS TIME

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210X or 215X	$765.00
w/noise blanker	$810.00
Accessories:	
AC Console 110/220 V	$155.00
Portable AC supply 110/220 V	$105.00
Plug-in mobile kit	$55.00
10X Osc. less crystals	$65.00
Digital Dial DD-9B	$238.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

HUSTLER

"the home of originals"

AMATEUR ANTENNAS

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS
Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS
Power Rating: Legal Limit SSB
Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

For 6-10-15-20-40-75-80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 96" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS
The Majority Choice of Amateurs Throughout the World!

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. Price: $22.00

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. Price: $22.00

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-STV
- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spirlz" extruded to otherwise unattainable close tolerances ensuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections ¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 9" MODEL 4-STV — Weight: 15 lbs. Price: $99.95

STANDARD GAIN MOBILES
Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL SBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MHL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75

MODEL SBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MHL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.85

HUSTLER "BUCK-BUSTER"

MODEL BF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included)
Price: $9.00

DELUXE MOBILE MOUNTS
For medium length, light weight antennas with ⅜" — 24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached.
Price: $17.20

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball.
Price: $8.00

MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors.
Price: $7.50

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included.
Price: $8.00

MODEL C-3S
Ball mount complete with mounting hardware.
Price: $8.20

SUPER GAIN MOBILES
Two Meters — CGT-144

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

MODEL CGT-144
Get big signal performance, superior receiving capability with this 65" cushcraft antenna. Easy installation on side or edge of trunk lip without drilling — Complete with 17' MHL SPEC RG-58-U and PL-259.
Price: $41.30

TWO AND SIX METERS— TRUNK LIP MOUNT — CS-144

MODEL MFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 48". Complete with trunk lip mount, 17' MHL SPEC RG-58-U and factory attached PL-259.
Price: $22.55

MODEL CS-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included.
Price: $25.50

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U.
Price: $9.95

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259.
Price: $16.85

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation.
$ 5.00

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL BSM-2
Heavy 2" reinforced stainless steel base with adjustable ball mount easily supports any resonator. Flexible stainless cylinder base, steel bolt-up and mounting hardware.
Price: $19.20

QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist motion. Corrosion resistant spring and all parts 100% stainless steel. ¼"-24 threads — base one end, male the other.
Price: $16.95

FEED LINE MODEL L-58-500
Get known performance, maximum shielding for minimum noise pick-up and the MHL SPEC 58 weight of RG-58-U cable. Supplied with connectors already attached, one with ball or bumper mount and transceiver.
Price: $6.55

MODEL 6S-144A — Deluxe, Two Meter Coilmeter for Repeater or any fixed station operation. 6 db gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator ⅝ wave lower section, ½ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. SO-239 coax connector
Price: $67.55

This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built-in balun. Up to 300 watts RF output. Matches everything from 160 thru 10 meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. $79.95.

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941 Versa Tuner II with all these features at this price:

A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balance lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your

ANTENNA SWITCH lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.

transmitter to **any** loadline from 160 thru 10 Meters whether you have coax cable, balance line, or random wire.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 5x2x6 inches fits easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balance line inputs (2), random wire input (1), and ground (1).

$59.95

BRAND NEW

MFJ-901 VERSA TUNER

Use efficient air wound coil for more watts out.

Only MFJ uses an efficient air wound inductor (12 positions) in this class of tuners to give you more watts out and less losses than a tapped toroid. Matches everything from 160 thru 10 Meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. Up to 300 watts RF output. 1:4 balun for balance lines. Tune out the SWR of your mobile whip **from inside your car.** Works with all rigs. Ultra compact 5x2x6 inches. SO-239 connectors. 5 way binding posts. Ten-Tec enclosure.

$49.95

BRAND NEW

MFJ-960 ECHO TUNER

Same as MFJ-901 Versa Tuner, but does not have built-in balun for balance lines. Tunes coax lines and random lines.

$39.95

MFJ-16010 RANDOM WIRE TUNER

Operate 160 thru 10 Meters. Up to 200 watts RF output. Matches high and low impedances. 12 position inductor. SO-239 connector. 3x3x4 inches. Matches 35 to 2500 ohms at 1.8 MHz.

$49.95

BRAND NEW

MFJ-202 RF NOISE BRIDGE

The MFJ RF Noise Bridge lets you adjust your antenna quickly for maximum performance. Eliminates mismatch frequency, radiation resistance and reactance. Switching range extended and expanded impedance range (.5 ohm to 5K ohms) gives you much extended measuring range.

Tells resonant frequency and whether to shorten or lengthen your antenna for minimum SWR. Adjust your single or multi-band dipole, inverted vee, beam, vertical, mobile whip or random wire. 1:1 balun system for maximum performance. 1.8 to 150 MHz. SO-239 connectors. 3x3x4 inches. 9 volt battery.

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER

$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

$17.95

NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code. For the Old Timer to polish his fist. For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

$29.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in.

$54.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying • 300 volts max • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches

$29.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatigue during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

$49.95

MFJ-1030BX Receiver Preselector

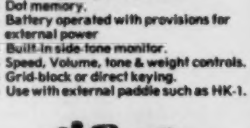
Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

THE HAM-KEY
NOW 5 MODELS

NEW MODEL HK-5 ELECTRONIC KEYER
$69.95

- Iambic circuit for squeeze keying.
- Self completing dots & dashes.
- Dot memory.
- Battery operated with provisions for external power
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.



Model HK-1 $29.95

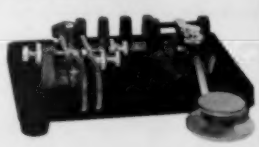
- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.

Model HK-2 $19.95

- Same as HK-1, less base for those who wish to incorporate in their own Keyer.

Model HK-3 $16.95

- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.



Model HK-4 $44.95

- Combination on HK-1 & HK-3 on same base.

TUFTS RADIO CATALOG TUFTS RADIO

vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS

RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 64.95
RX28C W/T	same as above–wired & tested.	117.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	64.95
RX50C W/T	same as above–wired & tested	117.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX114C W/T	same as above–wired & tested	119.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX220C W/T	same as above–wired & tested	117.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	84.95
RX432C W/T	same as above–wired & tested	129.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.95
RF28 Kit	10 mtr RF front end 10.7 MHz out	13.50
RF50 Kit	6 mtr RF front end 10.7 MHz out	13.50
RF144D Kit	2 mtr RF front end 10.7 MHz out	18.50
RF220D Kit	220 MHz RF front end 10.7 MHz out	18.50
RF432 Kit	432 MHz RF front end 10.7 MHz out	29.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	29.50
FM455 Kit	455 KHz IF stage plus FM detector	18.50
AS2 Kit	audio and squelch board	16.00

TRANSMITTERS

TX50	transmitter exciter, 1 watt, 6 mtr.	44.95
TX50 W/T	same as above–wired & tested	64.95
TX144B Kit	transmitter exciter–1 watt–2 mtrs	34.95
TX144B W/T	same as above–wired & tested.	59.95
TX220B Kit	transmitter exciter–1watt–220 MHz	34.95
TX220B W/T	same as above–wired & tested	59.95
TX432B Kit	transmitter exciter 432 MHz	49.95
TX432B W/T	same as above–wired & tested	79.95
TX150 Kit	300 milliwatt, 2 mtr transmitter	24.95
TX150 W/T	same as above–wired & tested	39.95

POWER AMPLIFIERS

PA2501H Kit	2 mtr power amp–kit 1w in–25w out with solid state switching, case, connectors	64.95
PA4010H Kit	2 mtr power amp–10w in–40w out–relay switching	64.95
PA50/25 Kit	6 mtr power amp, 1w in, 25w out, less case, connectors & switching	54.95
PA144/15 Kit	2 mtr power amp–1w in–15w out–less case, connectors and switching	44.95
PA144/25 Kit	same as PA144/15 kit but 25w	54.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	44.95
PA432/10 Kit	power amp–similar to PA144/15 except 10w and 432 MHz	54.95
PA140/10 W/T	10w in–140w out–2 mtr amp	219.95
PA140/30 W/T	30w in–140w out–2 mtr amp	189.95

Blue Line . . . RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	BAND	Power Input	Power Output	
BLC 10/70	144 MHz	10W	70W	149.95
BLC 2/70	144 MHz	2W	70W	169.95
BLC 10/150	144 MHz	10W	150W	259.95
BLC 30/150	144 MHz	30W	150W	239.95
BLD 2/60	220 MHz	2W	60W	164.95
BLD 10/60	220 MHz	10W	60W	159.95
BLD 10/120	220 MHz	10W	120W	259.95
BLE 10/40	420 MHz	10W	40W	179.95
BLE 2/40	420 MHz	2W	40W	179.95
BLE 30/80	420 MHz	30W	80W	259.95
BLE 10/80	420 MHz	10W	80W	289.95

POWER SUPPLIES

PS15C Kit	15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection.	94.95
PS15C W/T.	same as above–wired & tested.	124.95
PS25M Kit.	25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp, with meter	154.95
PS 25M W/T.	same as above–wired & tested.	179.95
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max.	12.95
PS3A Kit	12 volt–power supply regulator card with fold-back current limiting	10.95
PS3012 W/T	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	249.95

REPEATERS

RPT50 Kit	repeater–6 meter	499.95
RPT50	repeater–6 meter, wired & tested	799.95
RPT144 Kit	repeater–2 mtr–15w–complete (less crystals)	499.95
RPT220 Kit	repeater–220 MHz–15w–complete (less crystals)	499.95
RPT432 Kit	repeater–10 watt–432 MHz (less crystals)	579.95
RPT144 W/T	repeater–15 watt–2 mtr	799.95
RPT220 W/T	repeater–15 watt–220 MHz.	799.95
RPT432 W/T	repeater–10 watt–432 MHz.	849.95
DPLA50	6 mtr close spaced duplexer	575.95
DPLA144	2 mtr, 600 KHz spaced duplexer, wired and tuned to frequency	379.95
DPLA220	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.)	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

TRANSCEIVERS

TRX50 Kit	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals)	244.95
TRX144 Kit	same as above, but 2 mtr & 15w out	234.95
TRX220 Kit	same as above except for 220 MHz	234.95
TRX432 Kit	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	29.95
TRC-2	transceiver case and accessories	49.95

SYNTHESIZERS

SYN II Kit	2 mtr synthesizer, transmit offsets programmable from 100 KHz–10MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T	same as above–wired & tested.	239.95
SYN 220 Kit	same as SYN II Kit except 220-225 MHz	169.95
SYN 220 W/T	same as above–wired & tested	239.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching.	$ 7.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	15.50
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation	13.50
COR2 Kit	carrier operated relay.	22.75
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each).	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
MIC 1	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	35.95
TD3 W/T	same as above–wired & tested	59.95
HL144 W/T	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban	29.95
HL220 W/T	same as above tuned to 220 MHz ban	29.95
HL432 W/T	same as above tuned to 432 MHz ban	29.95

IC-211
4 MEG, Multi-mode
2 Meter Transceiver

ALL MODE

• 144-145 MHz operation on SSB and CW as well as 146-147 MHz operation on FM is possible with the IC-211. Try 144 MHz DX or just local rag chew with friends. Work the Amsat Oscar six or seven using the IC-211 for either the receiver or transmitter.

TUNING SYSTEM

• A large weighted flywheel knob mounted with low friction ball bearings is used to drive an optical chopper to provide pulses to the ICOM LSI synthesizer. A breaking mechanism, which operates inertially, changes to provide a smooth feel at slow speeds similar to the old PTO type units.

FULL FUNCTIONS BUILT IN

pulse type noise blanker
VOX with adjusting VOX gain, antivox
semi-break-in C. W. Operation
Built in SWR bridge
CW monitor
automatic power control
AC or DC operation

• The synthesizer designed by ICOM and implemented in the proprietary LSI chip operates in 100 Hz steps from 144 to 146 MHz and in 5 KHz steps from 146 to 148 MHz for FM operation.

• The IC-211 contains both the 117VAC and the 13.6VDC power supplies.

IC-245
146 MHz FM 10 W Transceiver

• The ICOM developed LSI synthesizer with 4 digit LED readout in the IC-245 offers the most for mobile. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the sideband adapter the step rate drops to 100 Hz, from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control.

• Optional equipment for the IC-245 includes a single sideband adapter which attaches as an integral part of the transceiver. With this easy to make conversion, your IC-245 operates in both FM and SSB/CW modes.

Master Charge and VISA accepted!

Master Charge and VISA accepted!

IC-502
6Meter SSB & CW Portable

• Get in on the fun of working 6 meters with this great portable radio. Operate QRP on 6 SSB or CW with this self contained transceiver, including antenna and battery pack. (Nicads and charger are now available.) Grab it and take it with you wherever you go . . . hill top, lakeside or car. The aluminum diecast frame provides a rugged radio for travel. Three watts PEP and the stable VFO make for fun and FB QSO's. There is even an RIT for the receiver, as well as a true I.F. noise blanker that really works on six meters!

• The VFO used in the IC-502 covers the first 800 KHz of the 6 meter band where most of the activity is. The excellent stability of the VFO and the smooth tuning dial make operating the IC-502 even in cold mountain top climates a pleasure worth the effort of getting there. The three watt PEP signal really gets through when the band is open and provides sufficient drive for an AB1 type linear amplifier.

IC-215
2 Meter FM portable

• An extremely rugged, high quality, radio with 15 channel capacity.

• The 'C' size cells may be replaced with rechargeable cells of the same size and very simple modification made to provide FULL CHARGE from either the auto electrical system or the IC-3PS power supply while the IC-215 is in operation. This feature is possible due to the BC-20 battery pack and charger.

IC-202
2 Meter SSB Portable

• A full 3 watts PEP from this compact transceiver is plenty of punch when the band is open. Three watts PEP will also dim most home-brew amps to full output or our optional amplifier to 10 watts.

• This unit also includes a true I.F. noise blanker that really gets the job done on reducing pulse type interference.

• The band switch selects 144.0, 144.2 or two other 200 KHz bands as selected by the user. Your ICOM distributor stocks 145.0-145.2 MHz and 145.8-146.0 MHz for the technician calling frequency and the satellite band.

ICOM

MODEL		MODEL	
IC-30A	399.00	RM-2	175.00
IC-202	259.00	IC245/SSB	444.00
IC-20L	98.00	IC-502	249.00
IC211	799.00	IC-50L	98.00
IC215	229.00	IC-701 AC	1,499.00
IC215/BC-20	249.00	IC-701 DC	PRICE
IC202S	335.00	IC-3PS	99.00
		IC-3PE	99.00

MIC-500M	Mobile Mic (specify model)	$18.00
SM-2	Electret Base Mic (for 4 pin mic conn)	34.50
IC-MM	Mobile Mount (specify model)	13.95
IC-DCC (22S)	DC Power cord (245,22S,211) w/fuse	3.00
IC-DCC (std)	Power cord (specify model AC or DC)	2.00
IC-PC	Power connector (specify model)	.50
RRD	Reverse dial (22A, 30A, 22S)	2.00
9PP	9 Pin Plug	2.00
BC-20	900 mAh Batteries & Charger for 202, 215, 502	49.95
24PP	24 Pin Plug	3.00
24PP set	24 Pin Set w/Bracket (22S)	6.00

DON'T FORGET $3.00 minimum

DON'T FORGET $3.00 minimum

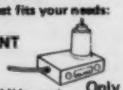
DON'T FORGET $3.00 minimum

DON'T FORGET $3.00 minimum

Larsen Külrod® Antennas

- Handle full 200 watts
- low-low V.S.W.R.
- Deliver 3 dB gain and more!
- Pick the one that best fits your needs:

MAGNETIC MOUNT
stays put even at 100 mph!



MM-JM-150 for 144 MHz use
MM-JM-220 for 220 MHz use
MM-JM-440 for 440 MHz use
} Only $38.50 complete

TRUNK LID MOUNT
No holes and low silhouette too!

TLM-JM-150 for 144 MHz use
TLM-JM-220 for 220 MHz use
TLM-JM-440 for 440 MHz use
} Only $38.50 complete

And 1/4 wave antenna for trunk and magnetic mount — $18.50

ROOF or FENDER MOUNT
Goes on quick and easy in 3/8" or 3/4" with fewer parts.

JM-150-K for 144 MHz use
JM-220-K for 220 MHz use
JM-440-K for 440 MHz use
} Only $31.50 complete

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

FULLY AIR TESTED — THOUSANDS ALREADY IN USE

#16 40% Copper Weld wire annealed to it handles like soft Copper wire — Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline — VSWR under 1.5 to 1 at most heights — Stainless Steel hardware — Drop Proof Insulators — Terrific Performance — No coils or traps to break down or change under weather conditions — Completely Assembled ready to put up — Guaranteed 1 year — ONE DESIGN DOES IT ALL.

MOR-GAIN

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
80-10 HD	80/40/20/15/10	78.50	50/1.40	69/21.0

NO TRAPS — NO COILS — NO STUBS — NO CAPACITORS

MOR-GAIN HD DIPOLES . . . ● One half the length of conventional half-wave dipoles. ● Multi-band, Multi-frequency. ● Maximum efficiency — no traps, loading coils, or stubs. ● Fully assembled and pre-tuned — no measuring, no cutting. ● All weather rated — 1 KW AM, 2.5 KW CW or PEP SSB. ● Proven performance — more than 15,000 have been delivered. ● Permit use of the full capabilities of today's 5-band xcvrs. ● One feedline for operation on all bands. ● Lowest cost/benefit antenna on the market today. ● Fast QSY — no feedline switching. ● Highest performance for the Novice as well as the Extra-Class Op.

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

■ All models above are furnished with crimp/solder lugs.
■ All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
■ 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

TUFTS RADIO CATALOG TUFTS RADIO

NEW
3s Monitor Antenna Tuner

- Continuous tuning 1.8–30 MHz
- Forward reading relative output power meter
- 300 watt power capability
- Built-in encapsulated balun
- Mobile mounting bracket
- Ceramic Rotary Switch 12-position
- Capacitor spacing 1000 volts
- Tapped toroid inductor
- Antenna inputs:
  a. Coax unbalanced SO239
  b. Random wire
  c. Balanced feedline 75–660 Ohm
- 5¼" w. x 2¾" h. x 6" d.
- All metal black wrinkle finish cabinet
- Weight: 2½ pounds

DenTron

AMPLIFIERS

MLA-2500 Amplifier (with Built-in Power Supply) $899.50
MLA-1200 Amplifier 399.50
AC-1200 / AC Power Supply for MLA-1200 ..... 159.50
DC-1200 / DC Power Supply for MLA-1200 ..... 199.50

TUNERS

MT-3000A Tuner 349.50
MT-2000A Tuner 199.50
160-10AT Super Tuner .. 129.50
Jr. Monitor Tuner 79.50

ANTENNAS

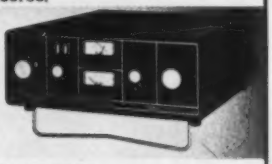
160M Mobile Antenna "Mobile Top Bander" (160 meters) . 59.50
Center Feed All Band Doublet Antenna 24.50

ACCESSORIES

Big Dummy with coolant .. 29.50
W-2 Wattmeter 99.50
160 XV Transverter "Top Bander" 249.50

Read forward and reflected watts at the same time

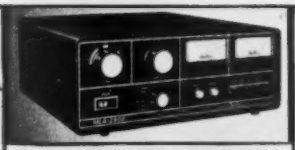
READ FORWARD AND REFLECTED WATTS AT THE SAME TIME. Tired of constant switching and guesswork? Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter. $99.50.



The MT-3000A
SPECIFICATIONS:

- Power handling capability in excess of 3 KW PEP
- Front Panel Antenna Switch with 5 Antenna Inputs plus Tuner bypass position
- Built-in 50 Ohm — 250 Watt dummy load
- Dual Wattmeters
- Compact: 5¼" x 14" x 14", 18 pounds
- Continuous Tuning 160-10 meters
- 3 Core Heavy-Duty Balun

160 XV MARS Dual Band 279.50
100 ft. 2kw 300 Transmission Line 19.50
100 ft. 470 Ohm Ladder Line 12.00
1 Kilowatt Balun 4:1 Chassis Mt. 27.50
3 Kilowatt Balun 4:1 Chassis Mt. 29.50

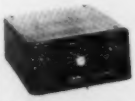


THE MLA-2500 SPECIFICATIONS

- 160 thru 10 meters
- 2000+ watts PEP input on SSB
- 1000 watts DC input on CW, RTTY, or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external-anode ceramic/metal triodes operating in grounded grid.
- Covers MARS frequencies without modifications
- Harmonic Suppression better than 50 dB
- Built-in ALC
- Built in RF Wattmeter
- 117V or 234 V AC 50-60 Hz
- Third order distortion down at least 30 dB
- Frequency Range: 1.8 MHz (1.8-2.5) 3.5 MHz (3.4-4.6) 7 MHz (6.0-9.0) 14 MHz (11.0-16.0) 21 MHz (16.0-22.0) 28 MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (standard 19" rack)
- Size: 5¼" H x 14" W x 14" D
- Weight: 47 lbs.

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.



Meet the SuperTuner

MEET THE SUPER TUNER 160-10 AT. The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?
1 KW MODEL $129.50.

B&W

Model 333 dummy load wattmeter — Favorite Lightweight Portable—250 WATT RATING — Air Cooled. Ideal field service unit for mobile 2-way radio — CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

Frequency Range:	DC to 300 MHz
VSWR:	Less than 1.3:1 to 230 MHz
Power Range:	250 watts intermittent
Wattmeter Ranges:	0-5, 0-50, 0-125, 0-250
Connector:	SO-239
Size:	4" x 7" x 8"
Shipping Weight:	7 lbs.
Price:	$69.50

High Power — 1000 WATT RATING — Oil Cooled — model 334A dummy load wattmeter. Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

Frequency Range:	DC to 300 MHz
VSWR:	Less than 1.3:1 to 230 MHz
Power Range:	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges:	0-10, 0-100, 0-300, 0-1000
Input Connector:	SO-239 (hermetically sealed)
Size:	4½" x 9" x 10½"
Shipping Weight:	12 lbs.
Price:	$174.00

Model 374 dummy load wattmeter — Top of the Line — 1500 WATT RATING — Oil Cooled. Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

Frequency Range:	DC to 300 MHz
VSWR:	Less than 1.3:1 to 230 MHz
Power Range:	1500 watts DC intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges:	0-15, 0-150, 0-300, 0-1500
Input Connector:	SO-239 (hermetically sealed)
Size:	4½" x 9" x 10½"
Shipping Weight:	12 lbs.
Price:	$215.00

Wide range attenuator — Model 371-1. Seven rocker switches provide attenuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

Power Capacity:	¼ watt
VSWR:	1.2:1 maximum, DC to 225 MHz
Impedance:	50 ohms
Accuracy:	1 dB/dB, DC to 60 MHz 0.1 dB/dB 30.0 dB, DC to 100 MHz 0.1 dB/dB 31.0 dB, DC to 220 MHz
Size:	2½" x 2½" x 2½"
Shipping Weight:	1½ lbs.
Price:	$40.50

Model 331A transistor dip meter — Portable RF single generator, signal monitor, or absorption wavemeter. Lightweight (1 pound, 6 ounces with all coils), battery-powered unit is ideal for field use in testing transceivers, tuning antennas, etc. Can also be used to measure capacity, inductance, circuit Q, and other factors. Indispensable for experimenters, it is easily the most versatile instrument in the shop. Continuous coverage from 2 MHz to 230 MHz in seven ranges.

Frequency Coverage:	2 MHz to 230 MHz in 7 overlapping ranges by plug-in coil assemblies: 2 MHz–4 MHz, 4 MHz–8MHz, 8 MHz–16 MHz, 16 MHz–32 MHz, 32 MHz–64 MHz, 90 MHz–110 MHz, 110 MHz–230 MHz
Accuracy:	2%
Modulation:	1000 Hz, 25% to 40%
Power:	9-volt transistor battery, Burgess 2U6 or equivalent
Size:	7" x 3½" x 2½"
Shipping Weight:	1 lb., 6 oz.
Price:	$130.00

Coaxial antenna changeover relay. Model 377.

Power Rating:	1000 watts CW (2000 watts SSB)
VSWR:	Less than 1.15:1, DC to 150 MHz
Power Requirements:	0.015 Ampere, 40 to 139 volts AC
Connectors:	UHF Type SO-239
Dimensions:	3½" x 1½"
Shipping Weight:	1 lb.
Price:	$17.95

Model 359. Increase your transmitter's effective speech power up to four times. This two stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters.

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2½" x 2" x 4½"
Shipping Weight	6½ oz.
Connectors	Terminal strip
Price:	$37.50

Model 372 CLIPREAMP. Get maximum legal modulation without danger of splatter.

Input Impedance:	100,000 ohms
Input Levels:	5 millivolts to 20 millivolts
Voltage Gain:	10 dB
Output Level:	60 millivolts
Output Impedance:	50,000 ohms
Power:	9-volt transistor battery, Burgess 2U6 or equivalent
Size:	2½" x 2" x 4½"
Shipping Weight:	7 oz.
Connectors:	Terminal strip
Price:	$27.50

PHONE PATCH

Universal hybrid coupler II phone patch. Model 3002W and model 3001W. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in Compreamp speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The Compreamp also functions as a preamplifier/limiter with the station microphone, if desired.)

Model 300 2W with Compreamp $125.00
Model 300 1W without Compreamp $85.00

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6½" x 7½" x 3"
Shipping Weight	3½ lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connectors	Phone

2-meter mobile AT-200 Antenna Matcher. Use your cars AM/FM antenna for your 2-meter mobile rig. Tunes from the front panel for max. output, min. VSWR (1.2:1 or less for most car antennas). $24.95

$69.95

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy – no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

SPECIFICATIONS

Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

GIANT SALE NOW IN PROGRESS!

GIANT SALE NOW IN PROGRESS!

GIANT SALE NOW IN PROGRESS!

The Bencher Ultimate Paddle . . . a dual lever, iambic keyer paddle that will increase your speed, accuracy & operating comfort.

● ADJUSTABLE CONTACT POINT SPACING — Precision screw adjustments on each set of contacts make exact settings easy. Contact posts are split and locked by set screws, eliminating the need for locknuts.

● WIDE RANGE OF TENSION ADJUSTMENT — Tension on finger knobs is maintained by a long expansion spring. Dual screw adjustments adjust spring tension to match your "fist."

● SELF ADJUSTING NEEDLE BEARINGS — Keying shafts pivot in nylon bearings that "float" on machined brass fittings. Spring tension prevents free play and slop; eliminates contact bounce and backlash.

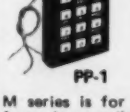
● SOLID SILVER CONTACT POINTS — The contact points are solid silver for a lifetime of flawless keying.

● PRECISION-MACHINED COMPONENTS — Main frame, contact posts, spring post and bearing ring are all machined from solid brass . . . polished and chrome plated for durability and rich appearance. The Bencher Paddle looks as good as it works!

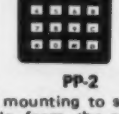
● HEAVY STEEL BASE; NON-SKID FEET — Finished in an attractive black wrinkle finish (chrome plating optional), the base measures 9.5cm x 10.2cm x 1.3cm thick. It weighs 1 kilogram, and with its non-skid rubber feet is as solid as a rock.

Model BY-1 Standard Black Base . . . $39.95. Model BY-2 Polished Chrome Base . . . $49.95.

BENCHER, INC.



PP-1



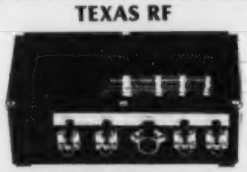
PP-2

M series is for mounting to surfaces inaccessible from the rear (walls, mobiles, systems interface, panels, test equipment). K series is self-contained with a relay inside the encoder. When keys are pressed contact closer occurs with a 2 sec. delay (adjustable). Contacts are rated at 110 mA @ 28 volts switched, 500 mA carry. PP-2K contains delay exclusion for the fourth column. However, by jumping D-5, 4th column is restored. Unit is operable from 4.5-60 volts at temperatures from 0°-140° F. Output level will drive any transmitter or system. Adjustable output level is controlled with an extremely stable multi-turn trimpot, w/access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved w/a system.

PP-1 $55 (12 keys); PP-1m $55 (lettering optional add $1), PP-1K $66; PP-2 $58; PP-2m $58 (lettering optional add $1); PP-2K $69, PP-1A $68 (for standard comm hand-held).

Pipo Communications

MICROWAVE MODULES TEXAS RF



MICROWAVE MODULES
HIGH PERFORMANCE UNITS
FOR 144, 432 and 1296 MHz

144 MHZ MOSFET CONVERTER – MMC144/28
With dual protected gate Mosfet RF Amplifier and Mixer stages
Input frequency: 144-146 MHz
I.F. output frequency: 28-30 MHz
Typical gain: 30 dB
Guaranteed maximum noise figure: 2.5 dB
Typical image rejection: 60 dB
Crystal oscillator frequency: 116 MHz (zener controlled)
Maximum frequency error at 144 MHz: 3 KHz
Power requirements: 12 volts DC ±25% at 60 mA
Other I.F. output frequencies available: 12-14, 14-16, 18-20, 24-26 MHz

144 MHZ MOSFET CONVERTER – MMC 144/28 LO
Similar to the MMC144/28, this unit features an additional 116 MHz buffer amplifier to provide a local oscillator signal suitable for transverter use.

144 MHZ DOUBLE CONVERSION MOSFET CONVERTER – MMC144/2 – MMC144/4
This unit has been developed to meet the requirement for a converter suitable for use with receivers having better performance at lower frequencies.
Input frequency: 144-146 MHz
I.F. output frequencies available: 2-4, 4-6 MHz
Oscillator frequency: 71 MHz (2-4 MHz IF), 70 MHz (4-6 MHz IF)
Maximum frequency error at 144 MHz: 3 KHz
Typical gain: 30 dB
Guaranteed maximum noise figure: 2.5 dB
Power requirements: 12 volts DC ±25% at 30 mA

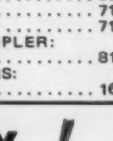
144 MHZ DUAL OUTPUT MOSFET PREAMPLIFIER – MMA144
This two-stage mosfet preamplifier has two separate isolated outputs, for feeding two receivers, for example.
Input frequency: 144-146 MHz
Typical gain: 18 dB
Guaranteed maximum noise figure: 2.5 dB
Bandwidth: 5 MHz at -3 dB, 8 MHz at -10 dB
Power requirements: 12 volts DC ±25% at 25 mA

432 MHZ MOSFET CONVERTER – MMC432/144
Two RF Amplifiers and a Mosfet Mixer combine high sensitivity and low cross-modulation characteristics.
Input frequency: 432-434 MHz
I.F. output frequencies available: 14-16, 18-20, 28-30, 144-146 MHz
Typical gain: 30 dB
Guaranteed maximum noise figure: 3.8 dB
Crystal oscillator frequency: 101 MHz (28-30 MHz IF) (zener controlled); 96 MHz (144-146 MHz IF)
Maximum frequency error at 432 MHz: 5 KHz
Power requirements: 12 volts DC ±25% at 45 mA

1296 MHZ CONVERTER – MMC 1296/28 – MMC1296/144
A hybrid ring mixer with a matched pair of hot-carrier diodes, driving a dual-gate mosfet I.F. amplifier.
Input frequency: 1296-1298 MHz
I.F. output frequencies available: 28-30, 144-146 MHz
Typical gain: 28 dB
Guaranteed maximum noise figure: 8.5 dB
Crystal oscillator frequency: 166.666 MHz (28-30 MHz IF) (zener controlled); 96 MHz (144-146 MHz IF)
Maximum frequency error at 1296 MHz: 28 kHz
Power requirements: 12 volts DC ±25% at 60 mA
Connectors: 50 ohm BNC

TRANSVERTERS:	
MMT 144/28	198.95
MMT 144/50	198.95
MMT 432/28S	259.95
MMT 432/50S	259.95
MMT 432/144S	298.95
RECEIVING CONVERTERS:	
MMC 144/28	55.95
MMC 144/28LO	60.95
MMC 432/28S	65.00
MMC 432/144	65.00
MMC 1296/28	71.95
MMC 1296/144	71.95
VARACTOR TIPLER:	
MMV 1296	81.50
ATTENUATORS:	
MAA 15	16.00

TEE/AX



Patent Pending — Model SW-5000

TEE/AX
Coax Toggle Switch — $39.95

● All brass construction ● Teflon insulated ● Captivated internal contacts ● available in UHF, BNC, N, E, all series. ● 52 Ohms ● SPDT, DPDT ● Power 1 KW

TEE/AX, INC.

AMPHENOL

SERIES 31 — BNC CONNECTORS
Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applications.
Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTROplated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25.

UG-1094

BNC (M) TO UHF (F) ADAPTER 349-2900-385 UG 255 Adapts any BNC jack to any UHF plug. $3.63

UG-255

DOUBLE MATE ADAPTER 83-277-385 Both coupling rings are free turning. Connects 2 female components. $2.72

83-277-385

JACK ADPATER $1.98 075-103-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE

SO239

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

PUSH-ON 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

UG-273

83-5SP-385

LIGHTNING ARRESTOR 075-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.85

075-105-385

BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 58/U & RG 58/U cables. $1.50

UG-88

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.18

UG-914

BNC PANEL RECEPTACLE 31-002-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

UG-290

83-878-385 SO239SH Mounts in single 31/32" diameter hole. Knurled lock nuts prevent turning. $1.59

SO239SH

BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

UG-306

BNC TEE ADAPTER 31-004-385 UG-274 Adapts 2 BNC plugs to 31-002-385 or other female BNC type receptakle. $4.56

UG-274

PL-259 . . . 90¢ UG-175 (Adapter for RG 58U) . . . 25¢

Model M-1S

Nemarc Auto Console Model M-1

- Universal mount for CB and amateur radios, tape players, AM & FM tuners, & scanners.
- Sculptured design for "original equipment" look.
- Low profile for non-slip mounting: 13-1/2" x 10-1/2" x 5-5/8" high.
- Easy-to-install & remove for theft protection.
- Tough unbreakable copolymer with rich brown textured finish.
- Integral cup holder and coin tray.
- $14.95

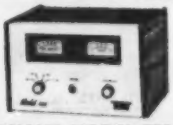
Auto Console Model M-1S: Same features as above model PLUS:

- Specially designed 3" x 5" oval speaker for voice communication. Frequency response: 150 hz–7 Khz, voice coil: 9/16" diameter.
- $19.95

Nemarc

TUFTS RADIO CATALOG — TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIO



ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 [illegible] output power, continuous wave. RF wattmeter SWR [illegible]. Power required 12-15 [illegible] @ 8 A, max. Construction [illegible] aluminum chassis, top and [illegible] panel, molded plastic [illegible] panels. Cream front panel, [illegible]ut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

DISCONTINUED

TRITON IV Digital Model 544

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes. For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age. But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air. The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as full CW break-in, preselectable ALC, offset tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW waveform, built-in SWR bridge and on and on.

TEN-TEC

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $69.50

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $39.50

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $17.00

KR50 ELECTRONIC KEYER

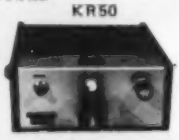
A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambie (squeeze) feature allows the insertion of dits and dahs with perfect timing.

Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2¼" x 5½" x 8¼"
Weight: 1¾ lbs.

KR50



FIRST WITH SSB HF DIGITAL TUNING, IS ONLY THE BEGINNING OF WHAT THE AMATEUR GETS FROM THE CIR ASTRO 200A.

Standard Features:
Electronic Tuning / All Solid State / Digitally Synthesized / 200 Watts PEP Input / Full RF Filtering / Digital Readout / Noise Blanker / Squelch / Variable Speech Processing / Full Metering / WWV Receiver / VOX / LSB-USB-CW

The heart of the ASTRO-200A is the frequency synthesizer. The latest in phase-lock-loop technology is incorporated to provide the built-in versatility of all electronic tuning, crystal frequency stability at each frequency of operation, and over 40,000 HF channels displayed in 100 Hz increments ... ±50 Hz fine tuning for continuous ham band coverage.

Each circuit board is "baked-in" for over 100 hours prior to installation in the transceiver assembly.

Discover the ease and accuracy of electronic tuning. Calibrate all bands with WWV at the turn of a switch. Lowest frequency drift, with no VFO to calibrate. Only 2.8" high x 9.5" wide x 12.3" deep. Ideal for mobile use or with accessories, provides complete fixed station operation. Price $995.00.

Accessories AC Power supply $135.00. Speaker in cabinet $29.95. Station operating console with phone patch, 24 hr. digital clock, speaker, 10 min. timer $295.00. Desk microphone $38.00. Mobile mount $12.00. Mobile mic $15.00. 400 Hz narrow band CW filter $50.00.

CIR TRANSCEIVERS

ACCESSORIES

206	Crystal Calibrator	$29.00
207	Ammeter for Models 251, 252G, 262G	14.00
208	CW Filter, for Model 509	29.00
212	Crystal, for Models 540, 544, 29.0-29.5 MHz	5.00
213	Crystal, for Models 540, 544, 29.5-30.0 MHz	5.00
215P	Microphone, Ceramic with plug	29.50
240	One-Sixty Converter, for Models 540, 544	97.00
241	Crystal Oscillator, for Models 540, 544	29.00
242	Remote VFO, for Models 540, 544	169.00
244	Digital Readout/Counter, for Model 540	197.00
245	CW Filter, for Models 540, 544	25.00
249	Noise Blanker, for Models 540, 544	29.00
271	Crystal, for Model 570, 21.0-21.5 MHz	5.00
272	Crystal, for Model 570, 28.0-28.5 MHz	5.00
273	Crystal, for Model 570, 28.5-29.0 MHz	5.00
276	Crystal Calibrator, for Model 570	29.00
1102	Snap-Up Legs, per pair	1.00

POWER SUPPLIES

210	117 VAC, 13 VDC, 1 A	30.00
210/E	Same as Model 210, but 115/230 VAC	35.00
251	117 VAC, 13 VDC, 9 A	85.00
251/E	Same as Model 251, but 115/230 VAC	92.00
252G	117 VAC, 13 VDC, 18 A	109.00
252G/E	Same as Model 252G, but 115/230 VAC	116.00
262G	Same as Model 252G, with VOX & speakers	139.00
262G/E	Same as Model 262G, but 115/230 VAC	146.00

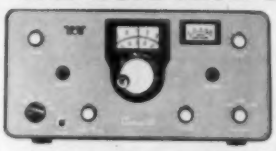
LINEARS AND TRANSCEIVERS

509	Argonaut Transceiver, SSB/CW, 5 W. 3.5-30 MHz	359.00
540	Triton IV, SSB/CW, 200 W. 3.5-30 MHz	699.00
544	Triton IV, Digital, SSB/CW, 200 W. 3.5-30 MHz	869.00
570	Century/21, CW, 70 W. 3.5-30 MHz	299.00
574	Century 21, Digital	399.00

KEYERS

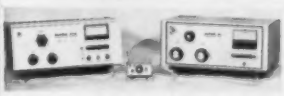
670	Single Paddle, for Model 570 only	29.00
KR-1A	Paddle Assembly, Dual	35.00
KR-2A	Paddle Assembly, Single	17.00
KR-5A	Single Paddle Keyer, 6-14 VDC	39.50
KR-20A	Single Paddle Keyer, 117 VAC/6-14 VDC	69.50
KR-50	Ultramatic, Dual Paddle, 117 VAC/6-15 VDC	110.00

THE SURPRISE OF THE CENTURY



Century 21, the exciting 70-watt, 5-band CW transceiver that surprised everyone with its super performance and low cost, has another surprise for you. A second model with digital readout (and a mod kit for those who would like to convert their dial model). Both Models 570 and 574 have the same unique circuitry that has won raves from everyone – both have the same fine features:

- **Direct Frequency Readout (Model 574:5 red LED digits, 0.3" high, accurate to nearest 1 kHz. Model 570: marked in 5 kHz increments from 0-500 kHz, MHz markings for each band displayed, tuning rate typically 17 kHz per tuning knob turn.**
- **Full Break-In**
- **Full Band Coverage on 3, 5, 7, 14, 21 MHz Bands, 1 MHz on 28 MHz Band**
- **70 Watts Input**
- **Total Solid-State**
- **Receives SSB and CW**
- **Receiver Sensitivity 1 μV**
- **Instant Band Change, No Tune-up**
- **Offset Receiver Tuning**
- **3-Position Selectivity**
- **Adjustable Sidetone Level**
- **Linear Crystal-Mixed VFO**
- **Overload Protection**
- **Built-In AC Power Supply**
- **Black & Gray Styling**
- **HWD: 6-1/8" x 12-1/2" x 12", 15-1/2 lbs.**
- **Matching Accessories**



- ALL THE ROCK-CRUSHING POWER YOUR LICENSE ALLOWS – on all modes –
- INSTANT BANDCHANGE 'NO-TUNE-UP' all the way from 10 through 80 meters, with the ALPHA 374A?
- COVERAGE ALL THE WAY DOWN TO 160 METERS with the smooth-tuning, extra-rugged ALPHA 76A powerhouse?
- CRISP, PENETRATING "TALK POWER" – as much as 10 dB extra to 'punch through', with the ALPHA/VOMAX split band speech processor?
- THE PROTECTION OF A FACTORY WARRANTY THAT RUNS A FULL 18 MONTHS – six times as long as competitive units? [ETO tries to build every ALPHA to last forever ... and we're making progress: not one single case of ALPHA 76A, 77DX, or 374A power transformer failure has ever been reported!]
- ALPHA 76A – $1195.00, ALPHA 77DX – $3295.00, ALPHA 374A – $1595.00.

ETO EIMAC TECHNOLOGICAL OPERATIONS INC.

TUFTS RADIO CATALOG — TUFTS RADIO

Vibroplex

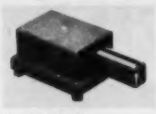
THE IMPROVED "ORIGINAL" VIBROPLEX. Suitable for All Classes of Transmitting Work Where Speed and Perfect Morse Are Prime Essentials. This great new Vibroplex is a smooth and easy working BUG. It has won fame on land and sea for its clarity, precision and ease of manipulation. Can be slowed down to 10 words per minute or less or geared to as high rate of speed as desired. Maintains the same high quality signal at whatever speed, insuring easy reception under all conditions. Weight 3 lbs. 8 oz.
DeLuxe — Chromium base and top parts, with jeweled movement. $59.95

THE "LIGHTNING BUG" VIBROPLEX High Quality Signals at All Speeds. Flat pendulum model. Weight 3 lbs. 8 oz. Standard — Polished Chromium top parts, grey base. $49.95

THE "CHAMPION" VIBROPLEX
Weight 3 lbs. 8 oz. Without circuit closer. Standard finish only. Chromium finished top parts, with grey crystal base. $46.50

VIBRO-KEYER
Over the years, we have had many requests for Vibroplex parts to be used for construction of a keying mechanism for an electronic transmitting unit. This beautiful and most efficient "Vibro Keyer" is ideal for this job.
FEATURES OF THE "VIBRO-KEYER"
- Beautiful beige colored base, size 3½" x 4½", weight 2¼ pounds
- Same large size contacts as furnished on Deluxe Vibroplex.
- Same main frame and super finished parts as Deluxe Vibroplex
- Colorful red finger and thumb pieces.
- Has the same smooth and easy operating Vibroplex trunion level
- A real "Gem" adjustable to suit your own "taste"

Standard — $46.50; Deluxe Finish $56.50



No. SSK-1 $23.95
No. SSK-1CP-Chrome — $29.95

NYE VIKING SQUEEZE KEY
Extra-long, finger-fitting molded paddles with adjustable spring tension, adjustable contact spacing. Knife-edge bearings and extra large, gold plated silver contacts! Nickel plated brass hardware and heavy, die cast base with non-skid feet. Base and dust cover black crackle finished. SSK-1 — $23.45.
SSK-1CP has heavily chrome-plated base and dust cover. Price — $29.45

CODE PRACTICE SET
You get a sure, smooth, Speed-X model 310-001 transmitting key, linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). Price — $18.50
PHONE PATCH Model No. 250-46-1 measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $36.50. Model 250-46-3, designed for use with transceivers having a built-in speaker, has its own built-in 2" x 6" 2 watt speaker. Measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. Price — $44.50

No. 114-320-003 — $9.90
No. 114-322-003 — Brass — $10.30
No. 114-320-001 — $8.20
No. 114-322-001 — Brass — $8.65
No. 114-310-003 — $8.25
No. 114-312-003 — Brass — $8.60

NYE VIKING SPEED-X KEYS
NYE VIKING Standard Speed-X keys feature smooth, adjustable bearings, heavy-duty silver contacts, and are mounted on a heavy oval die cast base with black wrinkle finish. Available with standard, or Navy knob, with, or without switch, and with nickel or brass plated key arm and hardware.
Pamper yourself with a Gold-Plated NYE VIKING KEY!
Model No. 114-31C-004GP has all the smooth action features of NYE Speed-X keys in a special "presentation" model. All hardware is heavily gold plated and it is mounted on onyx-like jet black plastic sub-base. Price $50.00

Mosley

● Model TA-33

- Model TA-33, 3 elements, 10.1 dB forward gain (over isotropic source) — $206.50
- Model TA-33 Jr., 3 elements, 10.1 dB forward gain (over isotropic source) — $151.85
- Model MPK-3, 7500 Watts AM/CW and 2000 Watts P.E.P. SSB — $52.25
- Model TA-36, 6 elements — $335.25
- AK-60 mast plate adapter — $11.15
- Model CL-33, 3 elements — $232.50
- Model CL-36, 6 elements — $310.65
- Model CL-203, 3 elements — $227.65
- Model TA-40 KR — 40 meter conversion kit — $92.25
- Signal-master antenna — $267.50

Wilson Electronics Corp.

COMMON FEATURES
- 6 Channel Operation
- Individual Trimmers on all TX/RX Xtals
- All Xtals plug in
- Microswitch control of TX/RX
- Rubber Flex Antenna furnished
- Convenient Size ... Fits in hip pocket
- 90 Day Warranty
- Can be modified for MARS or CAP
- Built for rugged use
- Inexpensive power source with rechargeable Ni-Cads
- Easily accessible circuitry
- One pair Xtals furnished with each radio installed.

1402SM: 146.52/.52 — 450SM: 446.00/.00
1405SM: 146.52/.52 — 2302SM: 223.50/.50

NEW 2 METER MARK II AND MARK IV
As the smallest size hand-helds ever marketed, the radios feature excellent adjacent channel selectivity, and innermod/image rejection. The attractive blue-gray Lexan® outer case is rugged and durable. Mark II (2.5 watt) $229.98. Mark IV (4 watt) $259.98

Riding the crest of the new wave of multi-channel two-meter rigs is the Wilson WE-800. Designed as an all-purpose mobile or portable unit, the WE-800 is loaded with enough features to satisfy even the most discriminating amateur. The "800" is for channels, from 144 to 148 MHz in 5 KHz steps, up or down 500 KHz for your local repeater. There are even provisions for pre-programming five of your favorite frequencies or changing to two optional offsets, in case your area repeater is nonstandard. Add to these features; internal rechargeable power pack optional (uses 10 AA NiCad cells, not included), detachable rubber flex antenna, built-in S-meter/output indicator, built-in high-low power option switch (1 or 12 watts, when used mobile or base), built-in connectors for external antenna, speaker and power. Whether you're just getting your feet wet on two-meters, or a seasoned amateur, you'll find the WE-800 to be the most lightweight, versatile base/mobile/portable rig on the market today. The WE-800 comes complete with plug-in speaker-microphone, mobile mounting bracket/handle, rubber flex antenna, 12V DC Charger Cord, instruction booklet and 90 day limited warranty. Rechargeable internal battery pack optional.

2 Meter Portable Amateur 800 channel Synthesized Radio 1 and 12 Watts RF Output 144-148 MHz

GENERAL SPECIFICATIONS

• Frequency range	144.000 - 147.995 MHz
• No. of channels	799 @ 5 kHz, or 399 @ 10 kHz
• Operating mode	Direct frequency modulation +
• Type of communication	Simplex or transmission offset (600 kHz)
• Operating voltage	13.6 VDC negative ground (10 to 15 VDC range)
• Current drain	Transmit 350 mA @ 1 watt output; 2 amps @ 12 watts output. Receive 45 mA squelched 220 mA @ full AF rated output
• Antenna impedance	50 ohms nominal
• Size	6 1/8 x 6 3/4 x 1 7/8 inches (209.6 x 171.5 x 47.6 mm)
• Weight	1 lb. 15 oz. (.8 1.5 kg) (3 lb. 11 oz. (1.6 kg) with batteries
• Frequency determination method	C MOS phase locked loop
• Offset Option	Two optional offset TX frequencies also available

LEATHER CARRYING CASE
- LC-1 for 1402 SM — $18.95
- LC-3 for Mark II, IV — $16.95
- LC-2 — all others — $18.95

110V-AC DESK BATTERY CHARGER
For new units Mark II, IV — use the Model BC-2; for Models 1402, 1405, 1407, 2202 and 4502, use Model BC-1. $40.95

WATT BATTERY CHARGER
110 V-AC Charger . . . use WC-12 ($19.95) for 1402, 1405, 1407, 2202, 4502; use WC-14 ($15.95) for Mark II, IV.
ACCESSORIES
BC-12 — $14.95
CIGARETTE LIGHTER MOBILE POWER PLUG
SPEAKER MIC
SM1 — for Models 1402, 1405, 1407, 2202, 4502.
SM3 — (Mark II, Mark IV)
SM2 for Models 1402, 1405, 1407, 2202, 4502. ($30.95).
RECHARGEABLE BATTERY PACKS
Use the following Ni-Cad Packs for the unit you select:
BP-1 — 10 loose cells — 500 mA (1402, 1405) — $18.95
BP-2 — strapped cells — 600 mA (1405, 2202, 4502) — $24.95
BP-4 — Mark II, Mark IV pack — $20.95
BP-7 — 1407 SM high power pack — $24.95
Other options include: Touch Tone® Pad (installed only), TE-1 Tone Encoder, TE-2 Encoder/Decoder, BNC Rubber Duck Antenna, TNC Rubber Duck Antenna.

There's nothing like it!

RADIO AMATEUR CALLBOOK — There's nothing like it! Foreign Radio Amateur Callbook DX Listings — $13.95; United States Callbook — All K&W Listings — $14.95.

SAVE YOUR RADIO!

DESIGNED FOR COMMERCIAL USE UP TO 1000 MHz.

The TUFTS SAVE-YOUR-RADIO bracket can save you a bundle . . . and a lot of hassle. Why worry about rig repair? The TUFTS SYR bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and out it out of sight.

The connector system has a sealed coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket . . . just what you need for hooking power and loudspeaker connections to the set.

This is a rugged bracket and connector system . . . it'll take a beating. There is a hole on each side of the 16 gauge steel plate for a padlock in case you want to leave the rig for short periods in its bracket. They'll have to rip out the dash to get it . . . and it won't be the first time for that.

With two of these brackets you can bring the mobile rig into the house and use it in seconds. On trips you can take an AC supply for the rig and use it in your hotel room. Price: $39.95

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

TUFTS SELECTED TITLES OF POPULAR SAMS PUBLICATIONS

RADIO HANDBOOK (20th Edition)

by William I. Orr, W6SAI. A completely updated 20th edition of the famous communications handbook that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radiocommunications equipment. Contains greatly enlarged section on semiconductor and IC circuit design. Includes ssb design and equipment; rtty circuits; linear amplifiers, both solid-state and tube types; vhf and uhf transmitters and converters; as well as special-purpose and logic circuitry, plus completely revised chapter on electronics mathematics. 1080 pages; 6½ x 9¼; hardbound.

No. 24032 **$19.50**

HAM AND CB ANTENNA DIMENSION CHARTS

by Edward M. Noll, W3FQJ. Tabulates dimension information in feet and inches for all the popular antenna configurations. Gives data for dipole antennas, quarter-wave verticals, two-element beams, quads, triangles, inverted dipoles, and inverted vees. Includes information for cutting transmission lines to a preferred wavelength, dimensioning phasing lines, cutting a matching stub, and spacing antenna elements. 64 pages; 6 x 9; softbound.

No. 24023 **$2.75**

COMMERCIAL RADIOTELEPHONE LICENSE QUESTION & ANSWER STUDY GUIDE (3rd Edition)

by Edward M. Noll. Prepares the reader to take the examinations for the various grades of radiotelephone licenses. Emphasizes those subjects that are most important or most likely to be misunderstood. The questions are representative of those used in the FCC examinations. 304 pages; 6 x 9; softbound.

No. 24033 **$8.50**

RADIO TRANSMITTER PRINCIPLES AND PROJECTS

by Edward M. Noll, W3FQJ. Devoted entirely to the subject of radio transmitters, this book is a helpful gathering of modern transmitter principles, ideas, circuits, techniques, and learn-by-doing projects. Covers Bipolar CW and A-M Transmitter Circuits, Transistor/Tube Circuits, Basic Principles of SSB-DSB Generation, Integrated Circuit Fundamentals, VHF/VHF Circuits and Principles, Frequency Modulation, and more. 320 pages; 5½ x 8½; softbound.

No. 24031 **$6.95**

73 DIPOLE AND LONG-WIRE ANTENNAS

by Edward M. Noll, W3FQJ. Covers practically every type of wire antenna used by amateurs. Gives dimensions, configurations, and construction data for 73 different antennas, plus appendices covering construction of noise bridges, line tuners, and data on measuring resonant frequency, velocity factor, and swr. 160 pages; 5½ x 8½; softbound.

No. 24006 **$5.50**

73 VERTICAL, BEAM, AND TRIANGLE ANTENNAS

by Edward M. Noll, W3FQJ. The second book in a series of practical antenna construction and design methods. Contains data on practically all types used by amateurs. Not a rehash of previously published data, but a compilation of the author's own experiments with various antenna configurations. The 73 different antennas have all been built and air-tested by the author. 160 pages; 5½ x 8½; softbound.

No. 24021 **$5.50**

FIRST-CLASS RADIOTELEPHONE LICENSE HANDBOOK (4th Edition)

by Edward M. Noll. An excellent study guide for the first-class radiotelephone license examination. Contains all the material needed to pass Element IV of the FCC examination, including all the questions and answers found in the latest FCC Study Guide. Has three simulated examinations, presented in the multiple-choice form of the FCC tests, as well as answers and evaluations to help the reader find his weak areas. 416 pages; 5½ x 8½; softbound.

No. 21144 **$7.95**

SECOND-CLASS RADIOTELEPHONE LICENSE HANDBOOK (5th Edition)

by Edward M. Noll. Provides all the study material needed to pass the FCC second-class radiotelephone license examination (Elements I, II, and III). All material is based on the *FCC Study Guide and Reference Material for Commercial Operator Examination.* Two tests are included to simulate the actual examination. 448 pages; 5½ x 8½; softbound.

No. 21111 **$7.95**

THIRD-CLASS RADIOTELEPHONE LICENSE HANDBOOK (4th Edition)

by Edward M. Noll. Serves as a practical study guide for the aspiring radio operator as well as a ready reference for those working in the field. Designed as a study aid for obtaining licenses up to and including the Radiotelephone Third-Class Operator Permit with Broadcast Endorsement, this newest edition contains questions and answers similar to those given on the actual examination. 208 pages; 5½ x 8½; softbound.

No. 21353 **$5.95**

CMOS COOKBOOK

by Don Lancaster. Tells all you need to know to understand and profitably use this inexpensive and genuinely fun to work with digital logic family. First an explanation of what CMOS is, how it works, and how to power it, plus usage rules, state testing, breadboarding, interface, and other basics is given. Then a minicatalog of over 100 devices, including pinouts and use descriptions is given. Subjects covered include gate fundamentals, tri-state logic, redundant logic design techniques, multivibrators, non-volatile memory techniques, clocked JK and D flip-flops, counter and register techniques, op amps, analog switches, phase-locked loops and much more. A must for the student, hobbyist, teachers, technician, or engineer who wants to learn about CMOS. Filled with practical applications. 416 pages; 5½ x 8½; softbound.

No. 21398 **$9.95**

IC OP-AMP COOKBOOK

by Walter G. Jung. The first book of its kind to be published. Covers not only the basic theory of the IC op amp in great detail, but also includes over 250 practical circuit applications, liberally illustrated. Organized into three basic parts: introduction to the IC op amp and general considerations, practical circuit applications, and appendixes of manufacturers' reference material. 592 pages; 5½ x 8½; softbound.

No. 20969 **$12.95**

IC TIMER COOKBOOK

by Walter Jung. Provides an excellent introduction to the field of IC timers by presenting a collection of various circuit "recipes" useful in applying the devices. Arranged in three parts, the first part gives basic and generalized information. Part II, the applications section, is the "meat" of the book and includes over 100 different circuits for a wide range of uses. Part III contains reproductions of manufacturers data sheets, second-source manufacturers, and more. This book is a valuable reference for the hobbyist, the technical or engineering student, or professional. 288 pages; 5½ x 8½; softbound.

No. 21416 **$9.95**

TTL COOKBOOK

by Donald Lancaster. A complete and detailed guide to transistor-transistor logic (TTL). Explains what TTL is, how it works, and how to use it. Discusses practical applications, such as a digital counter and display system, events counter, electronic stopwatch, digital voltmeter, and a digital tachometer. 336 pages; 5½ x 8½; softbound.

No. 21035 **$8.95**

HOW TO BUY & USE MINICOMPUTERS & MICROCOMPUTERS

by William Barden, Jr. Discusses these smaller computers and shows how they can be used in a variety of practical and recreational tasks in the home or business. Explains the basics of minicomputers and microcomputers, their hardware and software, peripheral devices available, and the various programming languages and techniques. Includes selection, buying, and programming your own system and gives detailed descriptions of currently available systems. 240 pages; 8½ x 11; softbound.

No. 21351 **$9.95**

MICROCOMPUTER PRIMER

by Mitchell Waite and Michael Pardee. Introduces the beginner to the basic principles of the microcomputers. Discusses the five main parts of a Computer—Central processing unit, memory, input/output interfaces, and programs. The important characteristics of several well-known microprocessors are given and a chapter is included on programming your own microcomputer. 224 pages; 5½ x 8½; softbound.

No. 21404 **$7.95**

THE 8080A BUGBOOK: MICROCOMPUTER INTERFACING AND PROGRAMMING

by Peter H. Rony, David G. Larsen, and Jonathan A. Titus. The principles, concepts, and applications of an 8-bit microcomputer based on the 8080 microprocessor IC chip. The emphasis is on the computer as a controller. Covers the four fundamental tasks of computer interfacing: (1) generation of strobe and device select pulses; (2) latching of accumulator output; (3) acquisition of input data by the accumulator; (4) generation of interrupt signals to the computer. Intended to help develop the skills needed to use an 8080-based breadboard microcomputer system. 5½ x 8½; softbound.

No. 21447 **$9.95**

F9FT TONNA ANTENNAS

9 Elements—144 MHz —$27.95

TECHNICAL DATA

Frequency range MHz	144/146
Gain ISO	14 dB
Horizontal aperture angle*	2 x 19°
Vertical aperture angle*	2x23°
Front-to-back ratio	15 dB
Side lobe attenuation	>50 dB
SWR	⩽1,3
Impedance	50
Weight	1,9 kg
Physical length	3,3 m
Windload*	6,4 kgp

*The indicated value is given at -3 dB

16 Elements—144 MHz —$55.95

TECHNICAL DATA

Frequency range MHz	144/146
Gain ISO	17,8 dB
Horizontal aperture angle*	2 x 16°
Vertical aperture angle*	2 x 17°
Front-to-back ratio	22 dB
Side lobe attenuation	>60 dB
SWR	<1,2
Impedance	50
Weight	4,4 kg
Physical length	6,4 m
Windload*	16 kgp

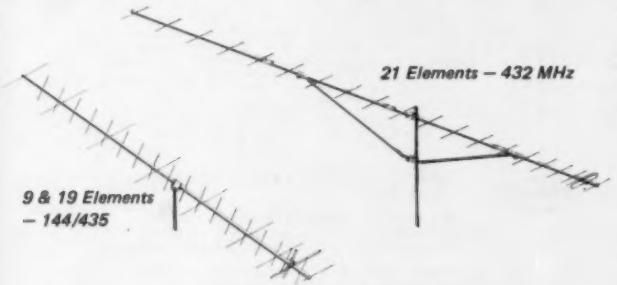
*The indicated value is given at -3 dB

21 Elements—432 MHz —$45.95

TECHNICAL DATA

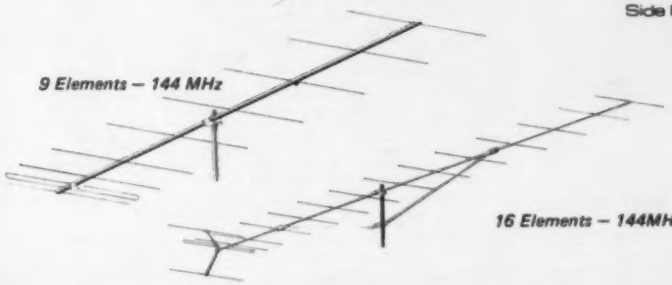
Frequency range MHz	432/435
Gain ISO	19 dB
Horizontal aperture angle*	2x12°
Vertical aperture angle*	2x13°
Front-to-back ratio	23 dB
Side lobe attenuation	⩾ 40 dB
SWR	⩽ 1,1
Impedance	50
Weight	2,6 kg
Physical length	4,6 m
Windload*	6,4 kgp

*The indicated value is given at -3 dB



21 Elements – 432 MHz

9 & 19 Elements – 144/435



9 Elements – 144 MHz

16 Elements – 144MHz

Special OSCAR—9 & 19 Elements— 144/435—$53.00

TECHNICAL DATA

Frequency range MHz	144/146	430/440
Gain ISO	14 dB	17 dB
Horizontal aperture angle*	2 x 19°	2x14°
Vertical aperture angle*	2x23°	2x16°
Front-to-back ratio	15 dB	23 dB
Side lobe attenuation	>50 dB	> 38 dB
SWR	⩽1,3	⩽ 1,2
Impedance	50	50
Weight	1,9 kg	1,1 kg
Physical length	3,3 m	3,2 m
Windload*	6,4 kgp	5,4 kgp

*The indicated value is given at -3 dB

HM-180

HM-187

HM-225

3 dB Gain High Performance Vehicular Antenna Series

HM-179 Low Profile Mount—$29.00
HM-180 Trunk Mount—$33.50
HM-187 Magnet Mount—$36.50

All new low profile antennas feature a 5/8 wavelength high conductive whip. Spring and whip may be removed leaving only 1-3/16" high base for minimal car wash clearance.
Coils are low loss, shock-resistant, directly fed ungrounded configuration and encased in plastic base. New high conductive whips are made of 17-7 PH stainless steel . . . coated with copper and nickel for high conductivity and greater heat dissipation. Mounts are Teflon-insulated, aluminum and plated steel.

ELECTRICAL SPECIFICATION

Antenna power rating:	100 watts
Frequency range:	144-148 MHz
VSWR:	1.5:1 or less
Nominal input impedance:	50 ohms
Transformer:	10 AWG copper wire, low loss coil, waterproof cover.
*Gain:	3 dB over 1/4 λ whip

HM-223 Trunk Mount—$29.00 (220 MHz)

3 dB Gain 5/8 λ Mobile Antenna on easy to install "Quick-Grip" trunk mount. Whip is easily removable for storage or car washes. 17' RG-58/U and connector.

ELECTRICAL SPECIFICATIONS

Gain:	3 dB
Bandwidth:	5 MHz
Power rating:	100 watts
Impedance:	50 ohms

MECHANICAL SPECIFICATIONS

Radiator:	135 ea. 17-7 PH stainless rods plated with copper and nickel
Length:	Whip 37"

HM-224 Trunk Mount—$33.50 (220 MHz)

The most powerful mobile antenna available for 1-1/4 meter mobile activity. 4 dB gain is achieved by stacking a 5/8 λ and 1/4 λ radiator. "Quick-Grip" trunk mount means easy no hole mounting. Whip is quickly removed for car washes or storage. 17' RG-58/U and connector.

ELECTRICAL SPECIFICATIONS

Gain:	4 dB
Bandwidth:	5 MHz
Power rating:	100 watts
Impedance:	50 ohms

MECHANICAL SPECIFICATIONS

Radiator:	17-7 PH stainless rods plated with copper and nickel
Length:	Whip 65"

HM-225 Unity Gain (marine mobile service) —$45.00 (220 MHz)

Unity Gain 3' fiberglass antenna for marine use. No ground plane required. Can be mounted or masthead on sailboats or on any vertical surface on power boats. Comes with 2' RG-58C/U cable.

ELECTRICAL SPECIFICATIONS

Gain:	Unity, ½ λ dipole reference
Power:	25 watts
Frequency range:	220-224 MHz
Impedance:	50 ohms

MECHANICAL SPECIFICATIONS

Length:	Approx. 3'
Radiator material:	Copper encapsulated in fiberglass
Mount:	Anodized aluminum bracket

the antenna specialists co.

HMR 172 5 Element Yagi—$30.00

Whether you use a low-powered QRP "touch-tone" rig or the full legal limit, the HMR172 offers 10 dB gain and 4 MHz bandwidth for superior performance under any band conditions. Can be mounted either vertical or horizontal. Adjustable gamma match for best possible VSWR.

ELECTRICAL SPECIFICATIONS

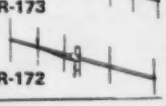
Forward gain:	10 dB
Front-to-back ratio:	15 dB
Bandwidth:	4 MHz
Nominal input impedance:	50 ohms
VSWR:	1.5:1
3 dB beamwidth:	68°
Power capability:	500 watts

MECHANICAL SPECIFICATIONS

Element configuration:	5 element yagi
Length:	8'
Turning radius:	3.5' (horizontal)
Weight:	3 lbs.
Rated wind velocity:	100 mph
Windload area:	.53 sq. ft.

HMR-173

HMR-172



HM 20 Marine Mobile Service—$39.00

Unity gain 5' fiber glass antenna for marine use. No ground plane required. Can be mounted on sailboats or on any vertical surface on power boats. Comes with 3' of RG-58C/U cable.

ELECTRICAL SPECIFICATIONS

Gain:	Unity (reference ½ λ, dipole)
Power:	25 watts
Frequency range:	140-148 MHz
Nominal impedance:	50 ohms

MECHANICAL SPECIFICATIONS

Length:	Approximately 5'
Radiator material:	Copper encapsulated in fiberglass
Mount:	Anodized aluminum bracket

HMR 173 11 Element Yagi—$52.00

Whether your interest lies in Moon Bounce, Tropo, or meteor scatter, the HMR173 is the solution to long-haul communications. The unsurpassed gain (13 dB) and 30° (3 dB) beamwidth makes the HMR173 the best antenna for the VHF world. Covers the entire 2 meter band. Can be mounted either vertical or horizontal. Adjustable gamma match. For maximum VSWR. – Information available on "high-gain" systems requiring 2,4, or 8 HMR173 yagi antennas.

ELECTRICAL SPECIFICATIONS

Forward gain:	13 dB
Front-to-back ratio:	15 dB
Bandwidth:	4 MHz
Nominal input impedance:	50 ohms
VSWR:	1.5:1
3 dB beamwidth:	30°
Power capability:	800 watts

MECHANICAL SPECIFICATIONS

Element configuration:	11 element yagi
Length:	17'
Turning radius:	9.3' (horizontal)
Weight:	6.5 lbs.
Rated wind velocity:	100 mph
Windload area:	1.39 sq. ft.

ASPR 619 Coupler—$17.00

Coupler for simultaneous 2 meter and AM/FM broadcast radio usage.

TUFTS RADIO CATALOG TUFTS RADIO

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

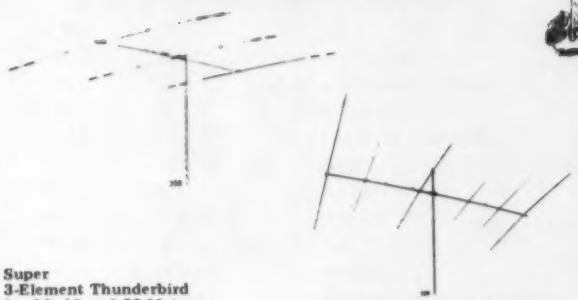
Matching speaker unit (3854) and complete external VFO (3855) also available.

See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

3854 3750 3855

There is no substitute.

hy-gain® Amateur Radio Systems.



Super 3-Element Thunderbird for 10, 15 and 20 Meters Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	TH6DXX	TH3Mk3
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 Pbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95 Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and re-adjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

HY-GAIN'S INCOMPARABLE HY-TOWER FOR 80 THRU 10 METERS

Model 18HT
- **Outstanding Omni-Directional Performance**
- **Automatic Band Switching**
- **Installs on 4 sq. ft. of real estate**
- **Completely Self-Supporting**

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power . . . delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 Ft., is 6061ST6 tapers aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower, Shpg. Wt., 96.7 lbs. Order No. 182, Price: $279.95
NEW Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level . . . permits easy raising and lowering of the antenna.

BROAD BAND DOUBLET BALUN
for 10 thru 80 meters
Model BN-86
$15.95

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95 Shpg. Wt. 1 lb. Order No. 242

MULTI-BAND HY-Q TRAP DOUBLETS
Hy-Q Traps

- **Install Horizontally or as Inverted V**
- **Super-Strength Aluminum Clad Wire**
- **Weatherproof Center and End Insulators**

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke . . . will not stretch . . . withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cyolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

MODEL 2BDQ for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs $49.95 Order No. 380
MODEL 5BDQ for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum power. Shpg. Wt., 12.2 lbs. $79.95 Order No. 383

CENTER INSULATOR for Multi-Band Doublets Model CI

Strong lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ¾" coaxial. Shpg. Wt., 0.6 lbs. $5.95 Order No. 155

MULTI-BAND ANTENNA
Dipole Antenna — Model DIV-80
$13.95
For 10 thru 80 meters — choice of one band

A dipole antenna for the individuals who prefer the "do-it-yourself" flexibility of custom-designing an antenna for your specific needs. (Work the frequencies you wish in the 10 through 80 meters bands).
The DIV-80 features: Durable Copperweld wire for greater strength, Mosley Dipole Connector (DPC-1) for RG-8/U or RG-58/U coax and all the technical information you will need to construct your custom-designed antenna.

END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

WIDE BAND VERTICAL for 80-10 Meters Hy-Gain's 18 AVT/WB

Take the wide band, omni-directional performance of Hy-Gain's famous 14AVQ/WB, add 80 meter capability plus extra-heavy duty construction – and you have the unrivalled new 18AVT/WB. In other words, you have quite an antenna.

- Automatic switching, five band capability is accomplished through the use of three beefed-up Hy-Q traps (featuring large diameter coils that develop an exceptionally favorable L/C ratio).
- Top loading coil.
- Across-the-band performance with just one furnished setting for each band (10 through 40).
- True 1/4 wave resonance on all bands.
- SWR of 2:1 or less at band edges.
- Radiation pattern has an outstandingly low angle whether roof top or ground mounted.

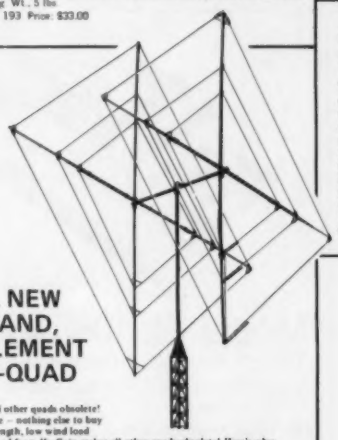
CONSTRUCTION . . . of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints . . . is so rugged and rigid that, although the antenna is 25' in height, it can be mounted without guy wires, using a 12" double grip mast bracket, with recessed coax connecter.

Order No. 386 Price: $97.00

The Versatile Model 18V for 80 thru 10 Meters

The Model 18V is a low-cost, highly efficient vertical antenna that can be tuned to any band 80 thru 10 meters by a simple adjustment of the feed point on the matching base inductor. Fed with 52 ohm coax, this 18 ft. radiator is amazingly efficient for DX or local contact. Constructed of heavy gauge aluminum tubing, the Model 18V may be installed on a short 1¼ inch mast driven into the ground. It is also adaptable to roof or tower mounting. Highly portable, the Model 18V can be quickly knocked down to an overall length of 5 ft. and easily re-assembled for field days and camping trips. Shpg. Wt., 5 lbs.

Order No. 193 Price: $33.00



ALL NEW 3–BAND, 2 ELEMENT HY–QUAD

- Makes all other quads obsolete!
- Complete – nothing else to buy
- High strength, low wind load

The Hy-Quad from Hy-Gain makes all other quads obsolete! Here's why:

First, it's the only quad that is complete. There is nothing more to shop for or buy.

Secondly, it is uniquely designed so that it overcomes all of the previously undesirable features inherent in quads.

The all aluminum structure stays up! The single feed line and diamond shape simplifies feed line routing.

Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything: spreaders are broken up at strategic electrical points with Cyclotac insulators / tri-band 2 element construction with individually resonated elements with no interaction / Hy-Quad requires only one feed line for all three bands / individually tuned gamma matches on each band with Hy-Gain exclusive vortex feed / full wave element loops require no tuning stubs, traps, loading coils or baluns / heavy duty mechanical construction of strong swaged aluminum tubing and die formed spreader-to-boom clamps / extra heavy duty universal boom-to-mast clamp that tilts and mounts on any mast 1¼" to 2½" in diameter / aluminum stranded wire. You can open and close the bands with this antenna. You'll experience the thrill of real DX.

Order No. 244 Price: $219.95

SPECIFICATIONS

Overall length of spreaders	25'5"	Forward gain	8.5 db
Turning radius	13'6"	Input impedance	52 ohms
Weight	42 lbs.	VSWR	1.2:1 or
Boom diameter	2"		better at resonance on all bands
Boom length	8	Power	Maximum
Mast diameter	1¼" to 2½"		legal
Wind survival	100 mph	Front-to-back ratio	25-35 db
Surface area	6.4 sq. ft.		depending upon electrical height
Wind load at 100 mph	256.0 lbs.	Polarization	Horizontal

hy-gain

For 10, 15, and 20 Meters
New Hy-Gain Model 12 AVQ

Completely self-supporting, the Model 12AVQ features Hy-Q traps...12" double-grip mast bracket...taper swaged seamless aluminum construction with full circumference compression clamps at tubing joints. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13'6". Shipping weight 7.2 lbs. Price: $47.00

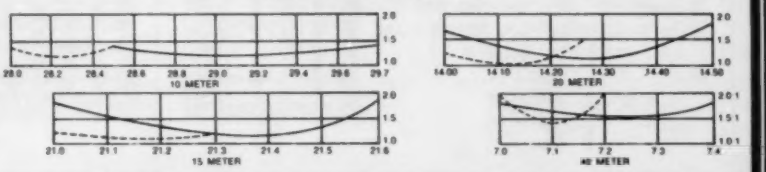
Order No. 384

New, improved successor to the world's most popular vertical!
Hy-Gain Model 14 AVQ/WB for 40-10 Meters.
● Wide band performance with one setting (optimum settings for top performance furnished)
● New Hy-Q Traps ● New 12" Double-Grip Mast Bracket ● Taper Swagged Seamless Aluminum Construction

The Model 14AVQ/WB, new improved successor to the world famous Model 14AVQ, is a self-supporting, automatic band switching vertical that delivers omni-directional performance on 40 through 10 meters. Three separate Hy-Q traps featuring large diameter coils that develop an exceptionally favorable L/C ratio and a very high Q, provide peak performance by effectively isolating sections of the antenna so that a true 1/4 wave resonance exists on all bands. Outstandingly low angle radiation pattern makes DX and other long haul contacts easy. Superior mechanical features include solid aluminum housing for traps using air dielectric capacitor...heavy gauge taper swaged seamless aluminum radiator...full circumference compression clamps at tubing joints that are resistant to corrosion and wear...and a 12" double-grip mast bracket that insures maximum rigidity whether roof-top or ground mounted. The Model 14AVQ/WB also delivers excellent performance on 80 meters using Hy-Gain Model LC-80Q Loading Coil. Overall height is 18 feet. Shipping weight 9.2 lbs. Unsurpassed portability...outstanding for permanent installations. Price: $67.00

Order No. 385

TYPICAL 14AVQ/WB VSWR CURVES



ROOF MOUNTING KIT– Model 14RMQ provides rugged support for Model 14AVQ/WB.
Order No. 184. Price: $28.95

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...

The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs.

Order No. 228 Price: $94.95

PRODUCTS OF SOUND RESEARCH
TELEX COMMUNICATIONS, INC.

Lightweight Headphones

HFC-91
Ultra-light underchin. Accoustic delay of 1 millisecond enhances intelligibility on CW or SSB. Low impedance 8-20 ohms. Shaped response – 100 - 3,000 Hz. 1.5 ounces.

Order by Catalog No. 18135-013 **$8.95**

HMC-2
Featherweight – Underchin, rugged aluminum tone arms direct signals into the ear – great for contests. 1.2 ounces, 100 - 3,000 Hz. Low impedance 8-20 ohms.

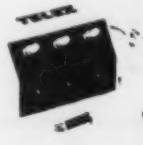
Order by Catalog No. 18183-002 **$13.85**

HTC-2
Lightest. Dual driver headset. Choice of the pros who must wear them for hours. 1.6 ounces, 100 - 3,000 Hz. Low impedance. 8-20 ohms.

Order by Catalog No. 3775-002 **$22.00**

PC-100 Headphone
Full cushion comfort – performance and long life make these dynamic phones ideal for novice or extra. 50 - 12,000 Hz. Low impedance. 8 - 200 ohms. weight 12 ounces.

Order by Catalog No. 63810-010
$16.95



Headphone Jack Box
Ham Clubs, field day, contest operation. No more "jury rigs" for multiple headphones. six 1/4" phone jacks with individual volume controls. 4 foot cord with 1/4" phone plug.

Order by Catalog No. 62753-000
$16.25

TUFTS RADIO CATALOG TUFTS RADIO

SHARP

CALCULATORS

Model EL-8131

8-Digit Calculator with Memory, Square Root and Percent

- 5-key direct access memory.
- Large, bright 8-digit display.
- Square root key.
- %-key.
- Clear and clear entry keys.
- Overflow error check device.
- Power: 2 "AA" batteries incl.
- Rechargeable Ni-Cad batteries and adapter/charger optional.
- 3 3/32" x 2 5/32" x 5 1/8"

$12.95

Model EL-500

6 + 2 Digit Scientific Calculator

- Scientific notation up to ± 99 dynamic range.
- Direct access memory.
- Degree, minutes, seconds to decimal degree conversion.
- Trigonometric, inverse trigonometric & logarithmic calc.
- Square root, root and pi keys.
- Power: 2 penlight batteries incl.
- AC adapter optional.
- 1 3/16" x 3 3/32" x 5 7/16"

$16.95

Model EL-5806

Billfold Type Advanced Scientific Calculator only 7.6mm Thin

- 8-digit mantissa/2-digit scientific notation.
- Pre-programmed for 24 functions.
- Statistical calculations.
- Easy to read Hi-Contrast LCD.
- Indicators for minus, memory, battery and statistical mode.
- Constant, chain, power, scientific and statistical calculations.
- 1,000 hours on 2 watch batteries.
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Charge!

—your nicads

When I began to think seriously about a charger for my portable radio, I looked through all my old issues of *73 Magazine*. I found quite a few articles on this subject, but none of them would fill the bill for the kind of charger that I needed. My new charger should charge at the proper rate until the battery is full and automatically switch to a trickle.

I have observed two properties of nicads whenever they become fully charged. One is the rise in temperature that occurs due to the inability of the cell to make a chemical conversion, which is dissipated as heat. The other is the slight rise in cell voltage from approximately 1.35 to above 1.4 volts. I don't know whether this rise in voltage is due to the increased temperature or is a physical property of a "flooded" cell quite apart from the temperature. A scheme of placing a thermistor next to the cells to control the charge was abandoned in favor of a means of sensing the voltage increase.

The general circuit is shown in Fig. 1. The filtered dc is current limited by R1 to a value one-tenth of the Ampere hour rating of the battery. Zener diode D1 provides a voltage offset so that all the voltage variation will appear across R2. This pot is adjusted so that the SCR will trigger on the voltage rise that occurs at the end of charge. Whenever the SCR triggers, R3 and R4 shunt most of the current away from the battery so that the battery is getting only a trickle. The LED will light, showing that the end of charge has been reached.

The switch S1 is used to take the SCR out of conduction and start the charge cycle.

Method

As there are many combinations of transformer voltage and number of nicad cells possible, I am going to leave the calculation up to you and will show the step-by-step design procedure. Only seven steps are required for your own situation:

(1) Specify battery —
N = number of cells,
A = Ampere-hour rating;

(2) Specify transformer —
E = rms secondary voltage,
V = 1.414E - 1.4;

(3) Calculate capacitor value — C = A/120 V (farads);

(4) Calculate R1 —
R1 = [V - N(1.4) - 0.7]/(A/10);

(5) Calculate offset zener voltage —
D1 = N(1.4) - 2.7;

(6) Calculate R3 —
R3 = [N(1.4) - 0.7]/[(A/10 - A/100) - .01];

(7) Calculate R4 —
R4 = [N(1.4) - 1.8] 100.

Example

Assume you have a battery of ten cells rated at 500 mAh and a transformer rated at 24 volts (a common voltage available in most junk boxes).

(1) N = 10, A = .5;
(2) E = 24, V = 32.5;
(3) C1 = .5/120(32.5) = 128 uF (use 200 uF, 35 V);
(4) R1 = (32.5 - 14 - .7)/.05 = 356 (use 360 Ohms);
(5) D1 = 14 - 2.7 = 11.3 (use 11 or 12 V zener);
(6) R3 = (14 - .7)/(.05 - .005 - .01) = 380 (use 390 Ohms);
(7) R4 = (14 - 1.8)100 = 1220 (use 1200 Ohms).

Construction

If you presently have a desk-top charger for your portable, you can modify the existing circuit. If you're not that lucky, then you may still get a professional-appearing unit by ordering the plastic parts for the charger from the manufacturer. I have built this unit for both a GE-PE and Motorola HT-220. Other portables have a jack for plugging in a charger. In this case, you can build your charger in any of several "project box" enclosures available at hobby electronics stores.

Testing

Substitute a variable resistor for the battery, and, with R2 turned off (wiper at ground), adjust the battery substitute until the desired trip point voltage is reached (1.4N volts). Then adjust R2 until the LED lights and stop there. Now connect your battery and push the switch; the LED should go out. The battery voltage should be between 1.25 and 1.35 volts per cell during charge and rise above 1.4 volts per cell at the end of charge.

Parting Shots

You should not trust this charger if ambient temperature is allowed to vary from that which is considered comfortable by most people. Too much heat or too much cold could alter the trip point. You may want to instrument this charger with a milliammeter and measure the various currents for the first few charge cycles, just to gain assurance that it is working okay.

I think I have told you all I know on the subject (not much really), but, if you have any questions, send an SASE and I will reply. ■

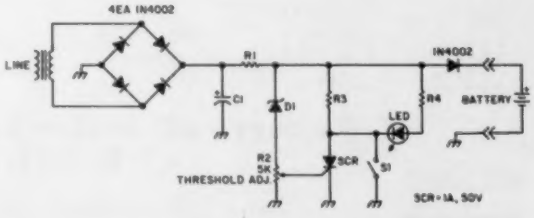

Fig. 1. General schematic for automatic-shutoff battery charger. For component values, see text.

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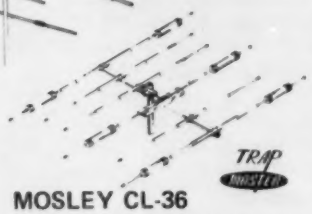

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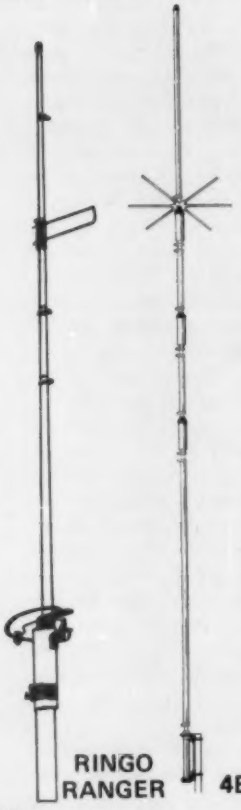

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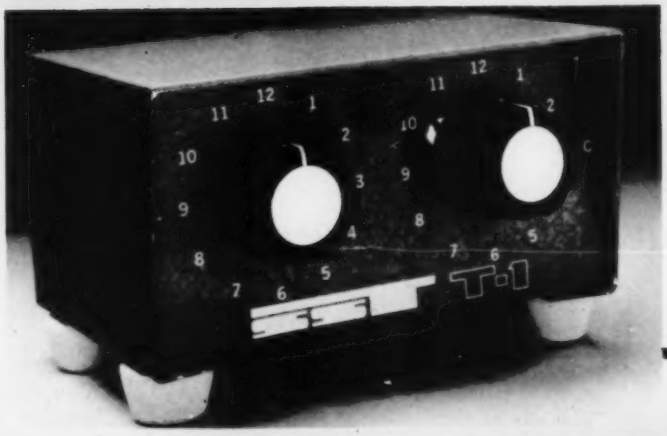

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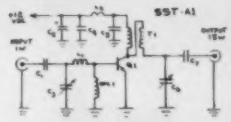

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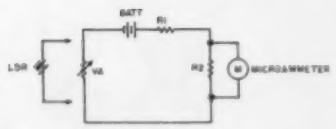


Fig. 1. Basic circuit for measuring resistance.

Many exposure timing devices have long been available to the photographer. Once this factor has been selected, we only need a dependable method of measuring the intensity of light striking the printing paper emulsion. My project, which I shall describe in this article, deals with a proven device for making these light intensity measurements with accuracy.

For many years I used the common and cheaper device consisting of a 117 volt ac line source, a neon lamp, a photo dependent resistor (LDR), and a variable resistant element potentiometer with linear-dial scale.

I learned to live with this for several years, and even after getting into color printing, decided that I was using too much time coordinating the enlarging lens aperture with the rheostat setting (which required two hands). A very unreliable potentiometer didn't help either. I always ended up in the ball park with this method, but not always exactly where I wanted to be. With many solid state devices and LDR cell types available, I embarked upon a new project, and after over two and one half years of actual use and testing, I can now present the project briefly. It can be built by anyone with radio equipment construction experience.

Fig. 2.

The instrument, a device for measuring light density, consists of three basic parts:
1. Light sensitive probe.
2. Dc differential amplifier.
3. Specially calibrated meter and face plate.

The Light Probe

The probe shown in Fig. 3 is constructed of semi-hard wood, such as poplar, a Clairex type 905HN light dependent resistance element, a 5 ft. cord (Belden #8411), and a standard Cannon

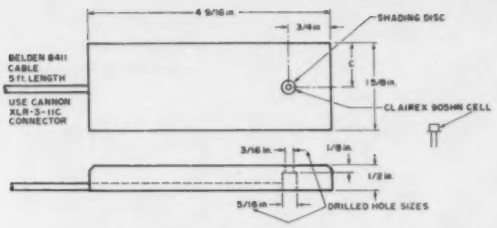


Fig. 3. Easel probe.

XLR-3-11c cord end-type connector. Epoxy cement and filler such as "Duro Epoxe #200H" manufactured by Woodhill Chemical Sales Corporation, Cleveland, Ohio, is used for filling and sealing the unit. I chose the Clairex 905HN light cell (after I had conducted tests on many of their types) because of its low "residual" characteristics, especially at the extremely low light levels used on most photographic sensitive papers. The sensitivity of the cell, along with its small cell aperture, makes it very complementary to the final calibrated probe. In constructing the probe, the case is grooved out through the center of the entire length, deep and wide enough so that the Belden type 8411 shielded cable will embed clear of the bottom probe surface. The photocell is mounted by insertion from the bottom of the case through a 5/16" hole drilled to within 1/8" of the top of probe case (where the hole continues through the top at 3/16" diameter). After the cell has been positioned and set, the two leads are connected to the shielded cable and soldered lightly (one center conductor, the other the shield). The small splices are then taped with plastic tape. Press the splices and cable into the groove channel, and then fill the entire groove channel with the epoxy cement. After over-filling the groove with epoxy cover, case the bottom with masking tape to prevent epoxy from seeping out (until it is set, in about 5 hours). After the epoxy has hardened, the masking tape can be removed and the case sanded down on the bottom to a finished surface. The top of the probe can now be painted white to within ¼" of the cell.

The Cannon XL3-11c can now be attached to cable end. Connect the shield to pins 1 and 2, and the center conductor to pin 3. Since the probe is not wired permanently to the electronics unit, more than one probe may be prepared for use with the instrument with flexible applications.

Calibrating the Light Probe

Since the photocells vary considerably(even within the same manufacturer's type) as to the effect they will have in this particular application, it was necessary in designing my system to permit or require aperture reduction in all cases to permit proper and consistent calibration of the instrument.

The procedure used to calibrate the probe requires the following equipment: a controlled light source (use your enlarger), an accurate standard exposure meter, and an accurate "ohmmeter" (range to over 100 megohms).

To begin, arrange the top of the probe at the exact level along with the exposure meter facing the projected light source. The exposure meter should be in the "direct" or "unshaded mode" if it has these options. Adjust the ASA setting on the exposure meter to 100. Adjust the projected light level (at least 1.5 ft. from the meter) using the enlarger lens aperture adjustment until the "F stop" indication is 5 for 1 second exposure.

With the "ohmmeter" or resistance measuring device connected to the end of the probe cable leads (shield and conductor), observe the resistance value. Normally, with the cell being used in this probe, the reading will fall in an area between 3.5 and 5.5 megohms. The cell is now calibrated by cementing a disc with a center hole or aperture drilled to a diameter large enough to produce a resistance reading of 6.4 megohms. The inside disc hole surface should be painted with flat black paint, especially if it has a reflected metal surface. The disc cemented to the top surface of the probe should be truly

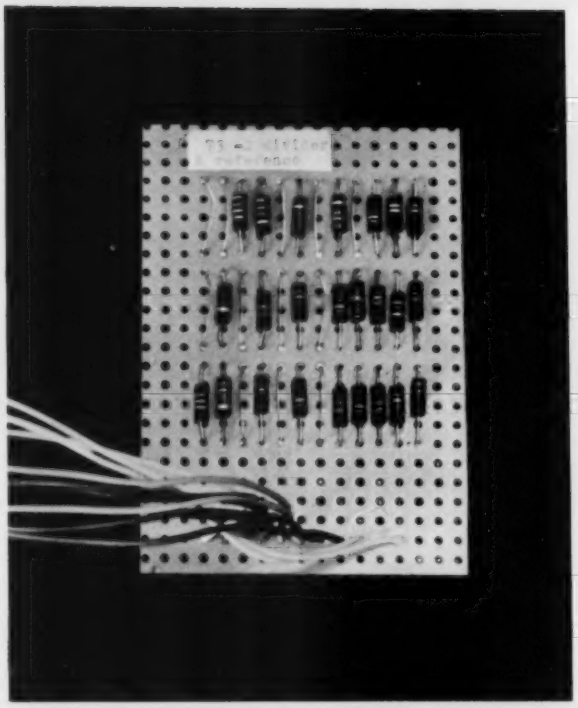
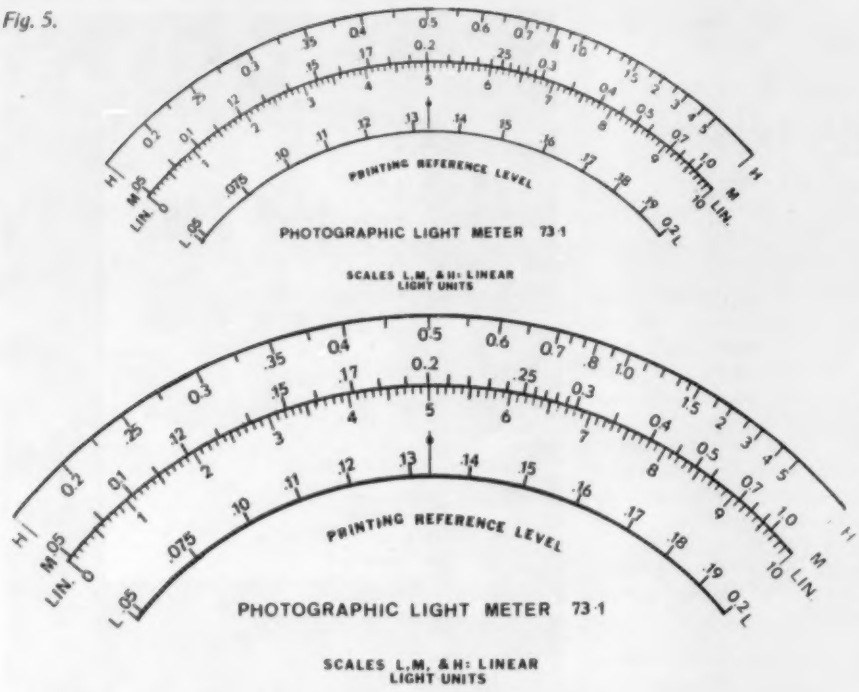


Fig. 4.

Resistance at P1, 2 & 3 term.	Linear scale reading
LOW RANGE	
78 megohms	1 (10%)
62 megohms	3 (30%)
55 megohms	5 (50%)
50 megohms	6 (60%)
42 megohms	8 (80%)
35 megohms	10 (100%)
MEDIUM RANGE	
70 megohms	1 (10%)
50 megohms	3 (30%)
35 megohms	5 (50%)
29.5 megohms	6 (60%)
16.8 megohms	8 (80%)
6.4 megohms	10 (100%)
HIGH RANGE	
31.5 megohms	1 (10%)
21 megohms	3 (30%)
14.5 megohms	5 (50%)
11.3 megohms	6 (60%)
5.3 megohms	8 (80%)
0.5 megohms	10 (100%)

Table 1. Linear scale meter readings for corresponding resistance values placed across P1 terminals 2 and 3.

Fig. 5.



centered over the photosensitive cell. After the cement is set, the calibration should be rechecked. If the resistance falls short of 6.4 megohms, a slight additional amount of shading can be accomplished by small pen and black lacquer. The temperature in the room area while calibrating probe should be approximately 75°F. If lacquer is used for final shading, the calibration should be checked several hours later for possible drift. The Clairex cell face is glass, and if reasonable care is taken, the black lacquer may be scraped off without damaging the cell face.

The Electronics Amplifier System

The electronics system consists of a divider card and dc amplifier. The divider card is very critical, but circuitwise very simple. Working with such high resistance values presents problems if

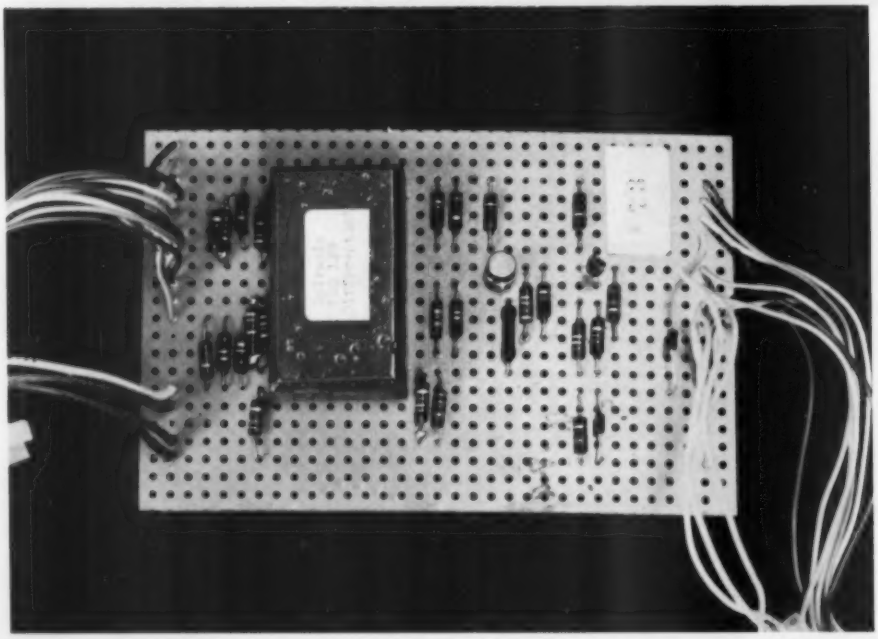


Fig. 7.

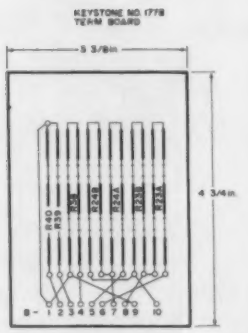


Fig. 6. Divider and Ref. card.

care is not taken to use materials that will prevent leakage in the circuitry; spray the entire card and resistor parts with clear lacquer under low humidity conditions after construction and calibration. I use several resistors in series to acquire most of the "total" values specified in this circuit, usually not exceeding 22 megohms each in value. Also, this provides great flexibility in arriving at the exact total value in each leg of the circuit. This portion of the electronics provides us with the very broad ranges and the unique meter scale shown. The divider card provides calibration references for the three ranges of this instrument. By designing the instrument so that the meter physical scale (full scale) is approximately one third of the theoretical full scale, the meter movement is the greatest for the smallest amount of input change, thus providing an instrument with greater accuracy in each scale range.

In soldering the resistors on the divider card, cooling time must be allowed before the total resistance value can be finally accepted for each circuit branch leg. A Keystone circuit board and Keystone 1562-2 connecting terminals are used in the model shown here.

The Dc Amplifier Circuit

As with most transistors, I find that great variations exist between the same manufacturer's types. The industrial grades vary more so, and for convenience and economy I

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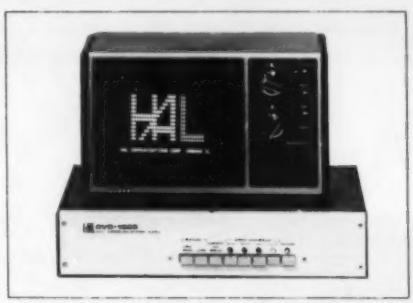

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specify "experimental" line transistors, GE FET N-channel, and GE 21 type in the final differential dc amplifier output stage. If the two transistors in the output-differential circuit are sealed closely in a common epoxy case, better calibration and less drift can be had. Using low leakage, wafer-type switches is a must in this device. The switching circuit provided here allows a constant check on the 22.5 volt battery supply. When the 4.5 volt battery falls below operational limits, full scale adjustment cannot be attained. Included in the switching system, I provided a quick "full scale" and "zero" adjustment test position. After running many tests under varying temperature conditions, a slight recalibration check was sometimes necessary; however, due to the "balance" leg arrangement in the divider card, the system is quite self-compensating.

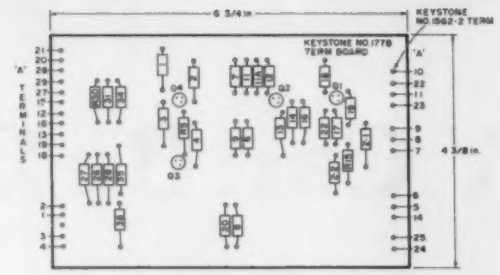

Fig. 8. Electronics card.

The model which I show here includes Waldom "molex" connectors. This does permit removing the divider card from circuit for testing purposes or replacing with spare. Another reason for using the connectors was for changing to divider cards for use with other light probe devices.

Final Calibration of the Instrument

By using the "actual" meter scale illustrated here with the Simpson Model #29 4" meter, the meter circuit is properly functional when the following test procedure is applied:

With the light probe disconnected from P1 (front panel), connect a resistance of exactly 35 megohms to pins 2 and 3 of the front panel connector. Next "ZERO" adjust the meter scale with function switch in the "ZERO ADJ" position. Now set the function switch to the "MEASURE" position, and the "RANGE" switch to the "LOW" range position. The meter should read full scale on "LOW" range. Now, set the "RANGE" switch to "MEDIUM." The meter should read half scale exactly. Note that there is a true linear scale on the meter face. On this scale, mid-scale would be "5."

If the foregoing procedure indicates meter calibration does not meet the specifications, the problem can be in two different areas. If the low range scale does not meet requirements, the problem lies in the dc amplifier gain and R11 may be adjusted either way to bring the "LOW" scale in. Once the "LOW" scale meets requirements, the "MEDIUM" scale is adjusted in the meter series and shunt resistance circuit for the "MED" range switch position. The divider card circuit remains the same for the "LOW" and "MEDIUM" ranges. The divider card circuit switches when the "RANGE" switch is set in the "HIGH" range position.

Since precise calibration procedures can become rather lengthy in discussion, it is assumed that anyone building this device is already sufficiently advanced in meters and dc amplifiers to proceed with the basic circuit schematic I provide here and understand the accompanying table.

The exact meter scale readings versus input terminal resistance values will provide you with the necessary information to attain the end result in final and correct calibration. A 40 microampere movement (Simpson shown here) allows for more latitude in final calibration, but more damping is had by using the more sensitive movement. I have run tests using a meter movement with a full scale deflection sensitivity of 5,000 Ohms per volt. Lower sensitivity meters don't have the extreme damp-

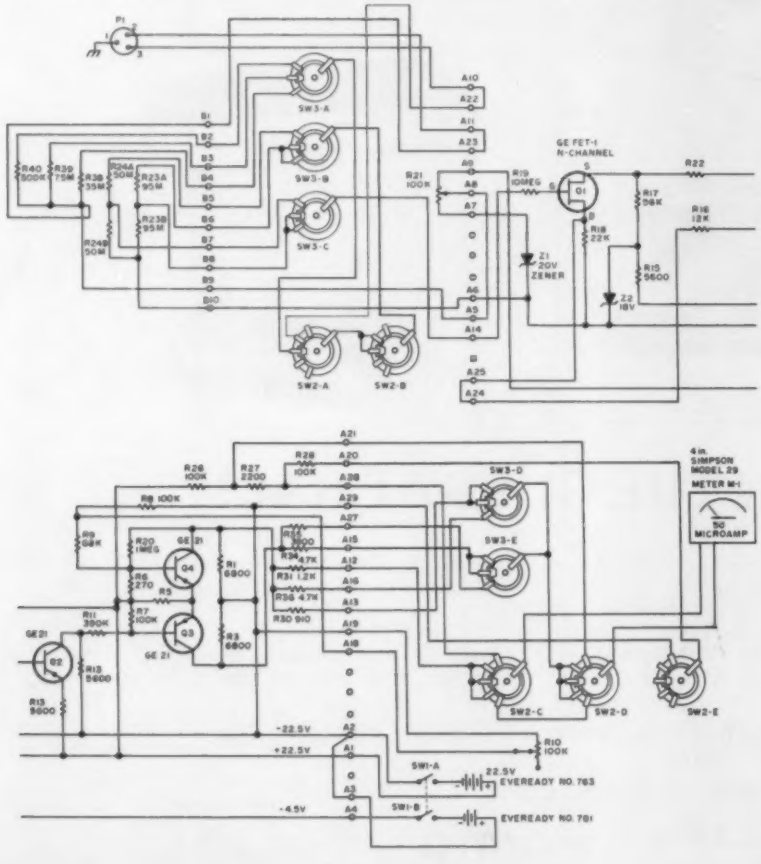

Fig. 9. Circuit schematic.

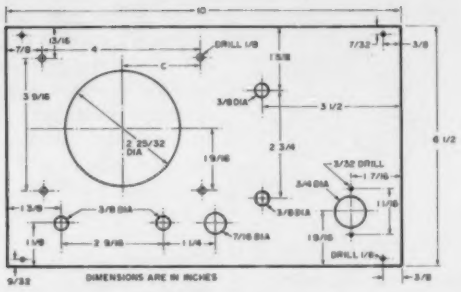

Fig. 10. Front panel.

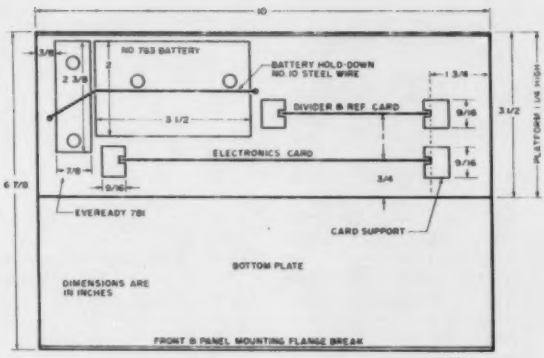

Fig. 11. Top view of chassis.

ing and don't require "tapping" the meter housing to establish the correct meter reading.

Going over the calibration procedure briefly, we have three separate sectional considerations in this device: (1) the meter divider card, which provides the inherent scale characteristics; (2) the dc amplifier, which provides the overall gain to drive the meter movement; and (3) the meter "dropping" and calibration circuit, which also is included in switching between the "LOW" and "MEDIUM" ranges.

An actual "cutout" meter scale which I provide in this article may be used by cutting it out and cementing it to the meter face of the Simpson model 29 meter. A larger illustration is shown, if a different basic meter movement is to be selected. I direct your attention to the 4 different scales on the meter. The three scales, "LOW," "MEDIUM," and "HIGH," are actual linear light level units, where the true meter linear scale is divided into 10 parts. This is universal and can be applied with accuracy in the original meter circuit calibration. It can be used alone if desired, so long as we have a reference point in our actual photographic printing. The light linear scale, however, is much more useful when, for instance, we wish to double or divide our exposure time by half, etc. Here, there is no guessing.

Using the Instrument

The instrument may be used in black and white or color photo printing work. The important feature on my instrument is the small aperture in the meter probe and the large meter movement for a small change in enlarger projected light intensity. In *any* case, a "test print" must be run off to establish a reference point in making subsequent prints. The reference point, of course, applies to one specific paper type and emulsion group. In the paper alone we have at least three variables to consider: paper emulsion sensitivity guide number, contrast curve, and emulsion age.

In using the printing meter, set the probe under a good reference spot right on the easel. Where people are included in the picture, the *best* spot to make all exposure measurements is on the open skin area such as the face. The arms or hands make an excellent place to take all readings. When making very small enlargements, it is very important here that the aperture or opening on the light probe *only* include the skin or flesh area. If other picture parts are included, the readings will cause great exposure error. I designed this instrument to solve this one common problem. I noted more errors on smaller enlargements than larger ones with several "beginners" who have used my instrument. If we had a constant "grey" reference area included on all negatives, it would be a perfect situation; however, many pictures don't even include a person for reference. In this case we may choose to use a sky area as a steady reference point, or a backdrop. In color photography the exposure is much more critical than black and white work. It was in doing color that I ran into problems with other light measuring instruments and finally became involved in the

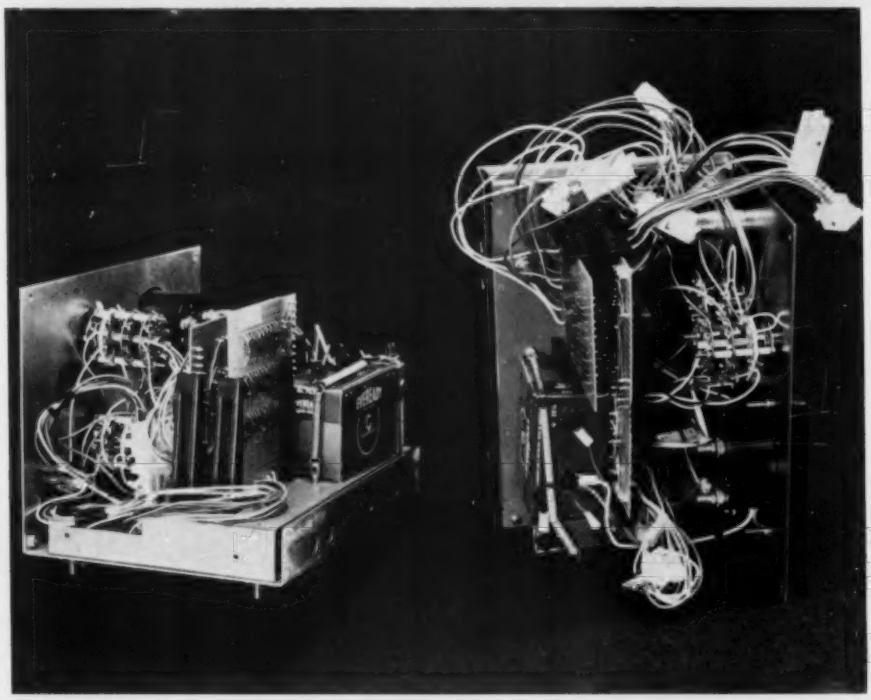

Fig. 12.

Resistors & Potentiometers

R1	6800	Ohms	½ W
R2	47k	Ohms	½ W
R3	6800	Ohms	½ W
R4	47k	Ohms	½ W
R5	4700	Ohms	½ W
R6	270k	Ohms	½ W
R7	100k	Ohms	½ W
R8	100k	Ohms	½ W
R9	68k	Ohms	½ W
R10	100k	Ohms	Linear taper potentiometer (zero adjust)
R11	390k	Ohms	½ W (strapped parallel with approx. 470k on final calibration)
R12	8200	Ohms	½ W
R13	5600	Ohms	½ W
R14	47k	Ohms	½ W
R15	5600	Ohms	½ W
R16	12k	Ohms	½ W
R17	56k	Ohms	½ W
R18	22k	Ohms	½ W
R19	10 meg	Ohms	½ W
R20	1 meg	Ohms	½ W
R21	100k	Ohms	Linear taper potentiometer (full scale adjust)
R22	180k	Ohms	½ W
R23a	95 meg	Ohms	½ W (combination of up to 6 resistors each not to exceed 22 megohms)
R23b	95 meg	Ohms	½ W (same as above note)
R24a	50 meg	Ohms	½ W (see above note)
R24b	50 meg	Ohms	½ W (see above note for R23a)
R25			(no)
R26	100k	Ohms	½ W
R27	2200	Ohms	½ W
R28	100k	Ohms	½ W
R29			(no)
R30	910	Ohms	½ W
R31	1200	Ohms	½ W
R32			(no)
R33			(no)
R34	4700	Ohms	½ W
R35	3900	Ohms	½ W
R36	4700	Ohms	½ W
R37			(no)
R38	35 meg	Ohms	½ W (use up to 6 resistors, each not to exceed 22 meg.)
R39	7.5 meg	Ohms	½ W (use up to 3 resistors)
R40	500k	Ohms	½ W (use up to 3 resistors)

Note: The divider card includes R23a, R23b, R24a, R24b, R38, R39, and R40. (Multiple resistance unit positions are provided as required to arrive at the precise value for each "R".)

Transistors

Q1	G.E. type FET 1
Q2	G.E. type GE 21 (Sylvania type ECG 129)
Q3	G.E. type GE 21 (Sylvania type ECG 129)
Q4	G.E. type GE 21 (Sylvania type ECG 129)

Switches

SW1	DPDT toggle switch
SW2	5 pole (5 position) wafer, use Centralab PA 2028 or equiv.
SW3	5 pole (3 position) wafer, use Centralab PA 2028 or equiv.

Other Items & Hardware

Z1	Zener diode, 20 volts
M1	Meter, Simpson Model 29, 50 microamp, 4½ inch face
P1	Cannon XL-3 M chassis mount connector
P2	Cannon XL-3 F Cord end type connector (probe cable)
LDR1	Probe element, Clairex type 905 HN
B1	Battery, Eveready type 763, 22.5 volts
B2	Battery, Eveready type 781, 4.5 volts
Card	Main electronics board, Keystone, cut to 4 3/8" by 6 3/4"
Card	Divider card, Keystone, cut to 4 3/4" by 3 3/8"
Z2	Zener diode, 18 volts 1 W

Connectors (Optional)

Connector A	Waldom (Molex) package # 1625 – 12 PRT
Connector B	Waldom (Molex) package # 1625 – 12 PRT
Connector C	Waldom (Molex) package # 1625 – 4 PRT
Connector D	Waldom (Molex) package # 1649 – 8 PRT
Connector E	Waldom (Molex) package # 1649 – 8 PRT

design of my printing meter.

I won't attempt to go into detail on printing color, but here, as in black and white, reference points such as flesh tones of persons are *best*. In color, I have found that a solid black area in the picture is a very good reference point once it has been established. Neutral or grey areas are very good. In addition to exposure and time, we have another problem in printing color from complementary color system negatives. Choice of proper light filtration is a very critical operation in color printing. Once we have established proper filter color balance, the last step is to arrive at the exact exposure for a selected exposure time.

Eastman Kodak Ektaprint 3 resin-coated back paper includes on each package the emulsion number, the reference color filtration compensation in yellow and magenta, and the emulsion sensitivity (speed) guide number. As an example: Choose 10 seconds as the exposure time on your timer. Now, keep it there. Select a picture color negative with a facial area in it. Turn the printing meter on and, having calibrated it for "ZERO" and "FULL SCALE," set the instrument to the "MEASURE" position. Place the probe cell aperture on the easel to include *only* the facial area. Adjust the enlarger lens aperture so that the reading on the printing meter "MEDIUM" scale is approximately .17 to .20 printing units. It will be found that this will be a good starting or reference point. It isn't my intention to go into color printing methods here, but with experience my instrument will save you time and money. The development of this printing meter is the result of long-time experience in the color field rather than just the need of a beginner. It is for this reason that I can say that it will serve you very well, whether you are a beginner or a professional.

I have been asked the question, "Why batteries?"

Well, here too from experience, the type of floor, humidity, and power distribution system in your area will cause great variations in external effects upon the instrument if it were common with a commercial power ac supply line. Longitudinal balance variations are avoided by the use of self-contained batteries. My system operates at extremely high input resistance values and, while it is advantageous instrumentwise, it is vulnerable to external electrical influences. Again, the probe and the main instrument in one case are separate units. Thus the instrument has many applications because it is flexible. All the parts shown in this project are simple, and familiar to all radio men. My last figures on the cost of the entire unit using the best meter movement and the connectors with all the trimmings came to approximately $150.00. This included the case and solid steel panel ready to go. ■

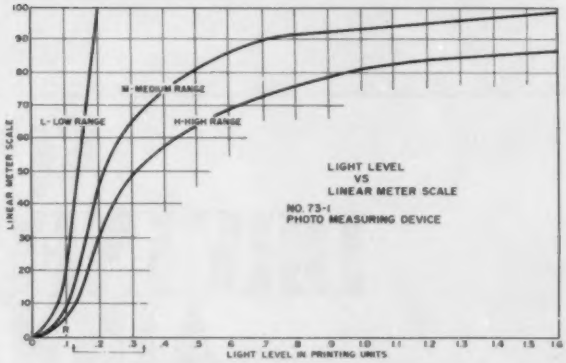

Fig. 13. Light level vs. linear meter scale.

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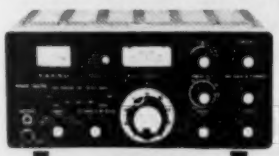

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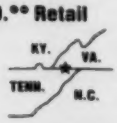

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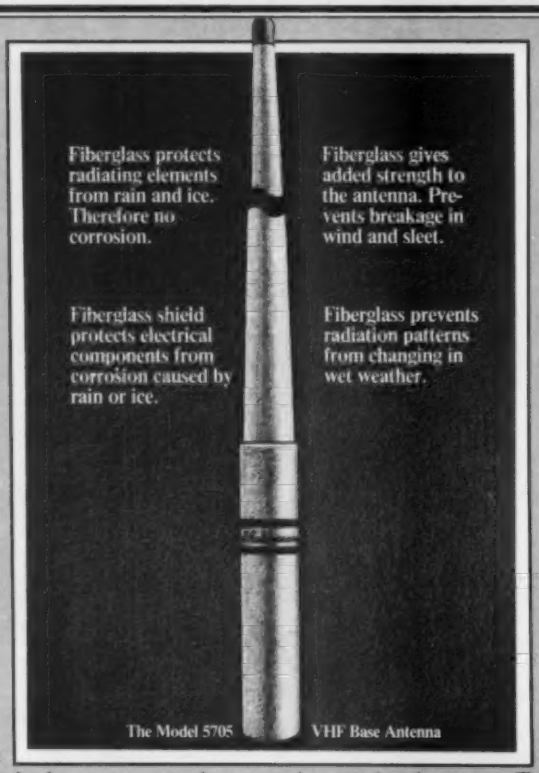
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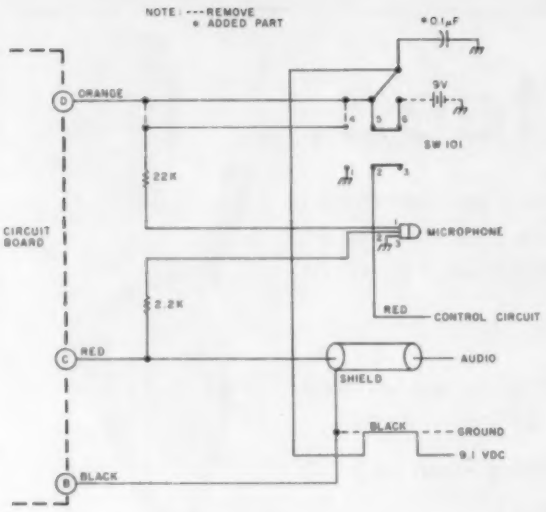

Fig. 1.

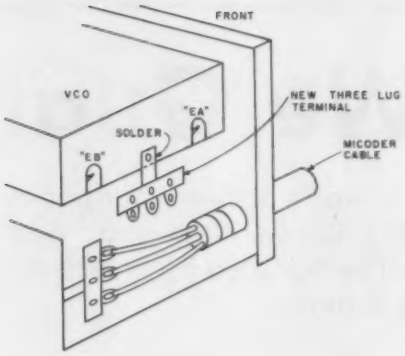

Fig. 2.

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I have made three changes on my Heathkit™ HW-2036 transceiver and the Micoder™ HD-1982 I use with it. The first two changes go together. They were instigated by my dislike of the nine-volt transistor battery. The third change is strictly an enhancement for ease of operation and to keep background noise from interfering with the tone while using the Micoder.

Following are the steps to use for the change that must be made to the Micoder to eliminate the 9-volt battery and obtain the 9-volt supply from the HW-2036.

1. Remove the 9 V battery wire from switch terminal SW101-6.

2. Remove the negative 9 V battery wire from the two-lug ground terminal.

3. Remove the black cable wire from the two-lug ground terminal. This wire will be used to carry the 9 V from the HW-2036 to the Micoder.

4. Remove the orange wire from switch terminal SW101-4 and reconnect it to switch terminal SW101-5.

5. Connect a 0.1 uF disk capacitor from switch terminal SW101-5 to the two-lug ground switch.

6. Connect the black cable wire to switch terminal SW101-5.

7. To improve oscillator stability, add two 0.01 uF capacitors. One should go from IC102, terminal 5, to ground; the other from IC101, terminal 5, to ground.

Fig. 1 shows the details. This completes the Micoder change. A companion change must also be made in the HW-2036, as follows:

1. Use a three-lug terminal with a center terminal ground support. Straighten the ground mounting strap and secure it to the longer side of the vco assembly so that the terminal lug is under the vco box. Use solder (see page 108 of the HW-2036 assembly instructions). The terminal should be mounted between the EB and EA solder lugs (see Fig. 2).

2. Assemble the capacitor, resistor, and zener diode to the three-lug terminal. Make sure the zener diode polarity is correct.

3. Remove the Micoder black cable wire from lug AT, terminal 2, and connect it to the new three-lug terminal 1.

4. Run a wire from the vco B terminal (11.1 V dc)

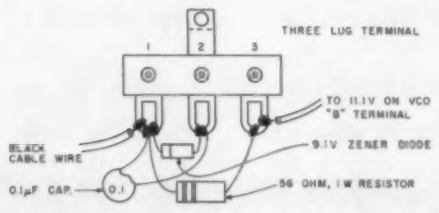

Fig. 3.

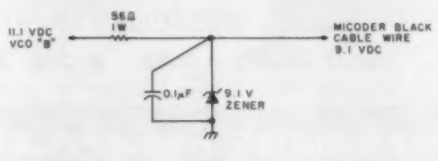

Fig. 4.

and connect it to the new three-lug terminal 3.

That completes the elimination of the 9-volt battery.

The third modification I made activates the push-to-talk when the encoder keyboard buttons are pushed (see Fig. 5). The R-C delay will keep the transmitter on while stepping from keyboard button to button. The PTT switch activator will not have to be squeezed. This will keep the microphone inactive so that background noise will not interfere with the tones. This modification can be accomplished only if the 9-volt battery has been removed. The circuit board will occupy its space. The new board fits between the microphone and the circuit board support posts. Secure the new board to the battery cushions on the lower case.

Diode D1 allows the 100 uF capacitor to charge when Q101 is active and blocks the 100 uF capacitor when it isn't active. When Q1 is active, it turns on the Q1 transistor, activating the control circuit. That turns on the transmitter. Capacitor C1 will discharge via R1, a 1k Ohm resistor, and through the base-to-emitter path of Q1 when Q1 is turned off. This will keep Q1 on for a second or so. Diode D2 will protect the Q1 transistor if the control circuit goes directly to a relay coil. ■

Parts List

2	0.1-uF disk
2	0.01-uF disk
1	56-Ohm, 1-Watt resistor
1	9.1-volt, 1-Watt zener
1	3-terminal connector
1	6-inch hookup wire, insulated
1	circuit board, approximately 29 x 45 mm
1	Q1 transistor NPN 2N2369
2	D1, D2 diode 1N002
1	R1 1000-Ohm, ¼-Watt resistor
1	100-uF 25-V dc capacitor

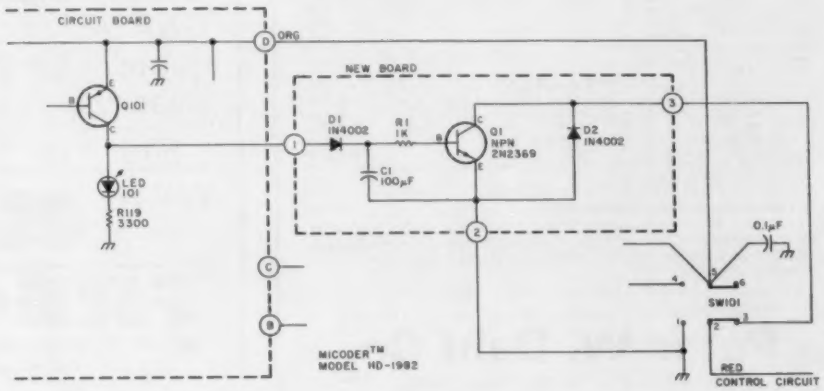

Fig. 5.

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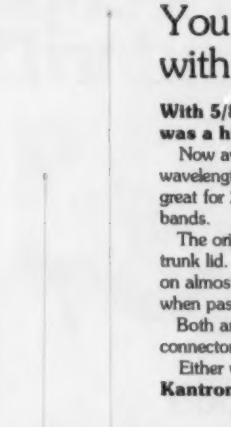

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Ham Help

I need a dial for a National model HRO7R receiver, and would also appreciate any information at all on HRO receivers.

Paul A. Yurko WD9HXM
230 West 45th Avenue
Gary IN 46408

I am looking for a meter for a Utica 650 six meter transceiver. I will pay for shipping.

Don W. Sartin WB3JYJ
10 Oak St.
Inkerman PA 18640

I am in need of diagrams and conversion help for a Gonset G-151 FM Communicator. I want to try to put it on 2 meters, if possible, and with 2 channels. I would appreciate any help.

Henry A. Simacek KØWJK
1600 Marion Rd. SE
Rochester MN 55901

I own a Heathkit HW-104 and would like to add RIT. Can someone who has added this modification send me information or make reference to an article already published?

Dan Atchison N3ND
112 Scotland Dr.
Newark DE 19702

I recently purchased a W9TO vacuum tube keyer at a hamfest. The problem is that the dots and dashes are the same length. I would greatly appreciate a schematic diagram or any information on this keyer. I am 13 years old and this is my first keyer.

Dave Preschel WB1FKO
20 Courtland Dr.
Shelton CT 06484

I need schematic diagrams for a Morrow 5BR-1 mobile converter, a Gonset model #3002 shortwave converter, and a Gonset model #3037 2 meter tuner. Any help would be greatly appreciated.

Joe Turkal K8EKG
1234 Concord NW
Massillon Oh 44646

I need the manual or copy of same for the Gonset Communicator III 6m with vfo. I also would like to know how to put the Gonset on FM. If anyone has what I need, I will gladly pay for it.

Jack Norris KL7IPM
PO Box 321
Talkeetna AK 99676

I, along with some other Greek hams, am interested in getting started on RTTY. We only know the basics, and the Greek market doesn't offer much from which to choose, but we want to give it a try. We want to hear from those who would be interested in getting us started and offering us some guidance. Thank you very much.

Manos Datkadakis SV1KB
PO Box 3751
Athens, Greece

I would like to borrow (for copy and return) a programming manual for a Tennelec Memory Scan programmable scanner. Or, if someone would send me the first ten, or so, frequencies and access codes from each band, I could work up a program from there. I would also like to borrow the service manual so I can retune the scanner for two meters. I would also like a copy of the schematic for a mobile power supply, but the programming instructions are most important as the radio is useless without them.

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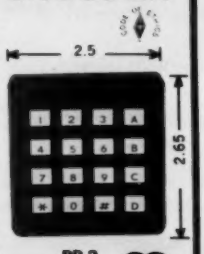

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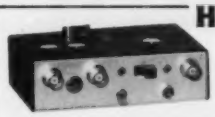

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Social Events

MORGANTOWN WV
SEP 3

The Monongalia Wireless Association will hold its second annual Mon Ham Gala on Sunday, Sepember 3, 1978, at Westover Park, 300 yards off I-79, near Morgantown, West Virginia. The activities begin at 10:00 am and end at 5:00 pm. Talk-in on 16/76. For complete information, contact John Curtis WB8AHH, 817 Willowdale Road, Morgantown WV 26505.

PENSACOLA FL
SEP 3

The Five Flags Amateur Radio Association will hold its annual Ham-A-Rama on September 3, 1978, at the University of West Florida field house in Pensacola FL. For additional information, write to the FFARA, PO Box 17343, Pensacola FL 32522.

SIERRA VISTA AZ
SEP 9

The Cochise Amateur Radio Association will hold its fourth annual Cochise Amateur Radio Round-Up on September 9, 1978, at the Sierra Vista Community Center, Sierra Vista, Arizona, starting at 9:00 am. Talk-in on .16/.76 and .52/.52. First prize is an Atlas 210X, and there will be many other prizes. Tickets are $3.00. For tickets and more info, write CARA, PO Box 1855, Sierra Vista AZ 85635.

UNIONTOWN PA
SEP 9

The Uniontown Amateur Radio Club will hold its annual Gabfest on Saturday, September 9, 1978, at the Club Grounds on the Old Pittsburgh Road, Uniontown, Pennsylvania.

MELBOURNE FL
SEP 9-10

The thirteenth annual Melbourne, Florida, Hamfest, sponsored by the Platinum Coast Amateur Radio Society, will be held Saturday and Sunday, September 9 and 10, 1978, from 9:00 am to 5:00 pm each day, in the air-conditioned Melbourne Civic Auditorium located on Hibiscus Boulevard. Donation is $3.50 per family. The program includes forums, meetings, swap tables, commercial exhibits, awards, and prizes. Talk-in on .25/.85 and .52. For more info, write PO Box 1004, Melbourne FL 32901.

SOUTH DARTMOUTH MA
SEP 10

The Southeastern Massachusetts Radio Association will hold its annual Flea Market Festival on Sunday, September 10, 1978, from 9:00 am to 5:00 pm at the Stackhouse Street Fairgrounds, South Dartmouth, Massachusetts. Rain date is September 17, 1978. There will be prizes, games, displays, refreshments, and many other activities. Admission is free. Space is $5.00 in advance; $8.00 at gate. Tables are $3.00 in advance; $5.00 at gate. Talk-in on 147.60/147.00 and 146.52. For complete information, contact Bob WA1ZXG or Rocky K1VJZ, S.E.M.A.R.A., PO Box 105, South Dartmouth MA 02748. For reservations: Attention, Armand WB1BUG.

MONTGOMERY AL
SEP 10

The Central Alabama Hamfest will be held Sunday, September 10, 1978, in the new Civic Center, Montgomery AL. There will be food service, prizes, air-conditioned exhibit areas, an indoor and outdoor flea market, and plenty of free parking. Admission and registration are free. For further information, contact Al Erdman W4CNQ, 3025 Pelzer Ave., Montgomery AL 36109, (205)-272-9130, or any amateur in the Montgomery area.

BUTLER PA
SEP 10

The Butler County Hamfest, sponsored by the Butler County ARA, will be held on Sunday, September 10, from 11 am to 4 pm at the Butler County Farm Show Grounds, adjacent to Butler Roe Airport (with a paved runway for fly-ins). Check-ins on 147.90/.30 and .52 simplex. Contact John K3HJH or Cliff WB3CDA for more details.

FINDLAY OH
SEPT 10

The second largest hamfest in Ohio, the 36th annual Findlay hamfest, will be held on September 10, 1978, rain or shine, at Riverside Park from 5 am to 5 pm. Watch for directional signs. There will be free parking, free reserved indoor space (bring your own tables), a massive swap and shop, and lots of prizes. A 2 meter hunt will be held at 1 pm and the main prize drawing at 3 pm. Tickets are $1.50 in advance, $2 at the door. Talk-in and prize check-in on 146.52. For tickets, space reservation, and further information, send an SASE to Clark Foltz W8UN, 122 West Hobart Ave., Findlay, Ohio 45840.

WILKES-BARRE PA
SEP 10

The Broadcasters Amateur Radio Club will hold its first annual hamfest at the Boston Store parkade, 30 South Franklin St., Wilkes-Barre PA on Sunday, September 10, 1978. In addition to ham exhibits, there also will be computer exhibits. Interested dealers and individuals should contact Charles Baltimore, 62 South Franklin St., Wilkes-Barre PA 18703, (717)-823-3101.

PECATONICA IL
SEP 10

The Rockford Hamfest '78 and Illinois State ARRL Convention will be held on Sunday, September 10, indoors at the Winnebago County Fairgrounds, Pecatonica IL. Prizes include a Tempo VHF One transceiver, a Tempo FMH two-meter HT, and a DenTron Jr. Monitor™ Antenna Tuner. Flea market tables are available. Lots of parking and campsites. There will be speakers, forums, displays, and ladies' programs. Tickets are $1.50 in advance and $2.00 at the gate. Talk-in on 01/61 or 52. For details, contact R.A.R.A., PO Box 1744, Rockford IL 61110. Please include a business-size SASE.

ELLETTSVILLE IN
SEP 10

The first annual Hoosier Backyard Hamfest, sponsored by the WR9AFY repeater and Community Broadcasting Corporation, will be held on Sunday, September 10, 1978, at the Phoenix Farm, State Highway 46 at the western city limits of Ellettsville, Indiana, approximately nine miles west of Bloomington, Indiana. There will be limited indoor space for noncommercial demonstrations, and a home brew contest. There will be acres of parking space for trunk sales, with limited overnight parking. Activities begin at 8:00 am and end at 4:00 pm. Admission is $1.00 per person. Children under 12 are free. Talk-in on 147.78/.18 (touchtone™ 7) and 146.04/.64. For further info or advance sales (SASE required), contact CBC, 7391 W. Hwy 46, Ellettsville IN 47429.

CHERRY HILL NJ
SEP 10

The South Jersey Radio Association hamfest will be held on Sunday, September 10, 1978, rain or shine, at the Ellisburg Shopping Center,

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Cherry Hill, New Jersey, at the intersection of routes 41 and 70. There will be a flea market, an auction, activities, and many prizes. Family registration is $2.00; tailgating is $3.00. Talk-in on .52. For further information, contact K2KA, Box 2736, Cherry Hill NJ 08002, or phone (609)-429-6032.

CONCORD NH
SEP 15-16

Evans Radio, Inc., Electrical Supply Company of Concord, New Hampshire, celebrates its 45th anniversary with an open house and trade show. The open house will take place on Saturday and Sunday, September 15 and 16, 1978, 9:00 am to 4:30 pm, at the firm's headquarters at Route 3A, Bow Junction, New Hampshire. The trade show will be held at the New Hampshire Highway Hotel and will feature 85 displays of electrical and electronic manufacturers' products. Buses carrying guests will run continually between the headquarters and trade show throughout the two-day celebration.

BUFFALO NY
SEP 16

The seventh annual Hamburg International Hamfest presents HAM-O-RAMA 78. This event will be held on Saturday, September 16, 1978, 9:00 am to 5:00 pm, at the Erie County Fairgrounds, Buffalo NY. Activities include speakers, big prizes, ladies' programs, major manufacturers' displays, and indoor and outdoor flea markets. Recreational vehicle hookups available. Talk-in on 146.52 and 146.31/.91. The fairgrounds are located off New York State I-90 at exit 57. For additional information, contact Bert Jones (716)-873-3984 or Jim Ciurczak (716)-297-0539.

HUDSONVILLE MI
SEP 16

The Grand Rapids Amateur Radio Association will hold its annual swap-n-shop on Saturday, September 16, 1978, at the Hudsonville fairgrounds, west of Grand Rapids on Hwy. #21 approximately ten miles. Talk-in on 14.16/.76 and 146.52. This will be an indoor and outdoor swap and shop. Tables are free; you can sell from the trunk of your car. There will be prizes, with one main door prize. Admission will be $2.50 at the gate. Room for 1,000 cars. Time: 7:00 am till 3:00 pm.

FALLS CHURCH VA
SEPT 16

The 1978 ARRL Technical Symposium will be held on Saturday, September 16, 1978, at the Tyson's Corner Ramada Inn, Falls Church, Virginia, in conjunction with the National Capitol DX Association's DXPO 78. This American Radio Relay League technical symposium is managed by the Amateur Radio Research and Development Corporation (AMRAD) and sponsored by the Northern Virginia Amateur Radio Council (NOVARC).

FALLS CHURCH VA
SEP 16-17

The National Capitol DX Association will sponsor DXPO 78 on Saturday and Sunday, September 16 and 17, 1978, at the Tyson's Corner Ramada Inn, near Interstate 495, Tyson's Corner, Virginia. The two half-day sessions will include DXpedition slide shows, contest tips, antennas, satellite DXing, and other special interest topics. A Saturday night banquet and hospitality session is included. The ARRL Technical Symposium is scheduled for the morning of September 16. Advance registration is recommended. Unless you have previously attended DXPO, write Dick Vincent K3AO, Rt. 1, Box 230, Bryantown, MD 20617 to be included on the mailing list.

KENNER LA
SEP 16-17

The Jefferson Amateur Radio Club, the Crescent City Computer Club, and the New Orleans VHF Club will hold their annual New Orleans Hamfest-Computerfest on Saturday and Sunday, September 16 and 17, 1978, at the Airport Hilton Inn in Kenner, Louisiana. Activities include forums on DX, antennas, hobby computers, and other phases of amateur radio, as well as demonstrations of satellite communication. FCC exams will be given to those with proper advance reservations. A luau with music and entertainment is planned for Saturday night. Talk-in on 146.34/.94. For complete details and reservation information, write New Orleans Hamfest-Computerfest, PO Box 10111, Jefferson LA 70181.

PEORIA IL
SEP 17

The Peoria Area Amateur Radio Club will hold its 21st annual hamfest on September 17, 1978, at the Exposition Gardens on W. Northmoor Road in Peoria, Illinois. Admission to the grounds and swapfest is free; tickets will be sold for a drawing to be held in the Youth Building at 3 pm. Advance tickets are $1.50; tickets at the door will be $2. Camping space will be available Saturday night on the grounds. Space will be available for net meetings and a ladies' flea market; there will be movies and forums of interest to all throughout the day. Commercial exhibitors and manufacturing representatives will give product demonstrations. For the ladies, there will be a free bus trip to the Northwoods shopping mall with more than 100 different shops. An informal get-together will be held at

Continued on page 226

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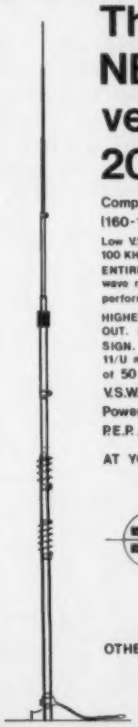

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The instrument described in this article will meet all of the above requirements; it is immune to accidental shorts which often occur in the course of trying a new circuit and will, therefore, be a useful addition to any laboratory.

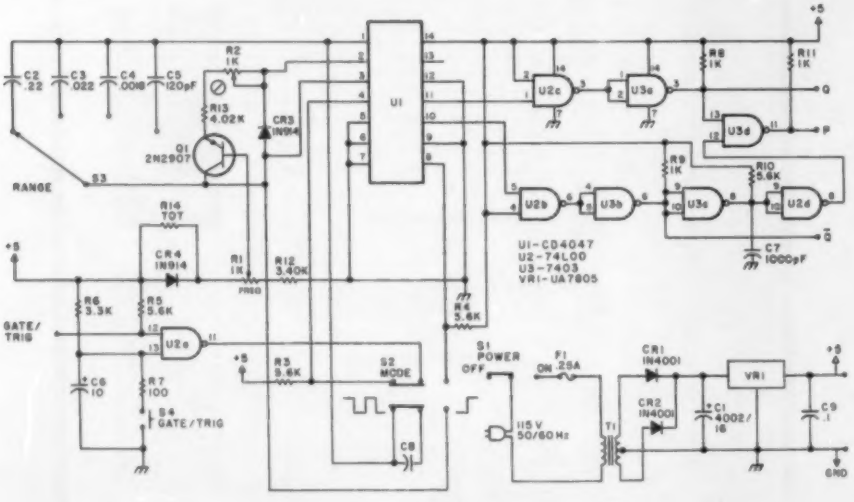

Fig. 1.

Condensed Specifications

Power supply: 5 ± 0.25 V dc at 1 Amp, short-circuitproof; automatic thermal shutdown. *Astable oscillator:* 10 Hz to 100 kHz, providing simultaneous true and complementary square waves and 1 μs pulses, TTL-compatible, short-circuit protected; manual and/or remote gating. *Monostable oscillator:* Simultaneous true and complementary pulses variable from 5 μs to 50 ms. TTL-compatible, short-circuit protected; manual and/or remote triggering.

About the Circuit

Power Supply

The power supply is shown schematically in the lower portion of Fig. 1. It is a basic full-wave rectifier, capacitor input supply, followed by an IC regulator capable of delivering in excess of 1 Ampere at 5 V, while being fully protected against

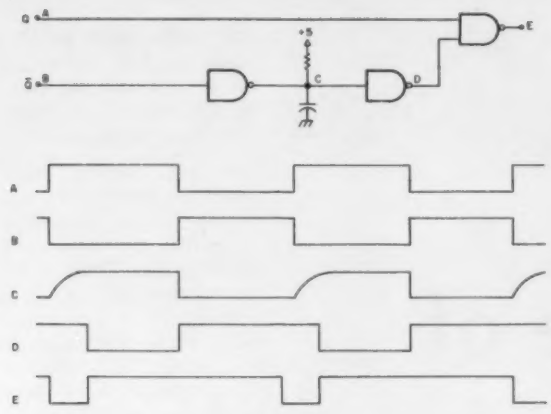

Fig. 2.

sustained shorts and overloads. The power transformer secondary is rated at 16 V c-t at 1.5 Amps; these are the minimum parameters to guarantee proper operation under worst case line and load. The IC regulator (7805) has internal thermal protection and must be heat sinked to at least 15 square inches of 1/16" aluminum sheet metal.

Astable oscillator

The heart of the oscillator circuit is U1, a CD 4047 IC. Its operating mode, i.e., astable or monostable, is controlled by the logic state at terminals 4 and 8. As shown in the schematic, with pin 4 grounded and pin 8 high, the astable mode is established. The oscillator may be inhibited by raising the level on pin 4; this is achieved by grounding either of the two inputs of gate U2A. The frequency of oscillation is determined by the charging time of the frequency range capacitors, C2-C5. When used in accordance with the IC manufacturer's recommendations, the frequency would be continuously varied by varying the resistance between pins 2 and 3. Unfortunately, this yields a frequency calibration proportional to 1/R and a highly nonlinear dial for a linear taper potentiometer. This problem has been overcome in this circuit by replacing the variable resistor with a variable current source, consisting of Q1 and R2 + R13. The base voltage of Q1, adjusted by linear potentiometer R1, linearly varies the current through R2, and hence inversely varies the effective resistance between pins 2 and 3. A perfectly linear frequency calibration is thus achieved. CR4 and R14 act as a temperature-compensating network for the current source.

The CD 4047 has an internal divide-by-two flip-flop and therefore produces highly symmetrical square waves at terminals 10 and 11. Gates U2C and U3A couple and buffer the Q output, and gates U2B and U3B act similarly for the $\overline{Q}$ output of the oscillator. An open-collector gate was chosen as the output device, in spite of its slower rise time, because of its wired-OR capability and, hence, its inherent immunity to accidental shorts to ground.

A 1 μs pulse is generated by combining a delayed $\overline{Q}$ with an undelayed Q. Fig. 2 shows this circuit and its corresponding timing diagram. As a rule of thumb, a 6000-Ohm pull-up resistor and a 1 μF capacitor will yield a 1 ms delay; this relation is quite linear with capacitance. If, in your particular application, a pulse width other than 1 μs is needed, just change C7 to the required value.

Monostable oscillator

The monostable mode is established by grounding U1-8 (through U2A) and by applying a logic "1" to pin 4. The one-shot is triggered by momentarily raising the level at pin 8. This is accomplished by the output of gate U2A, which will go high when either the GATE/TRIG terminal is grounded or push-button switch S4 is depressed. R7 and C6 act as a debouncing circuit. The period of the one-shot is related to the astable frequency, such that $T \approx 1/f$. A correction capacitor C8 shunts all range capacitors (C2-C5) in the monostable mode.

Parts List

C1	4000 uF, 16 V, electrolytic capacitor
C2	0.22 uF
C3	0.022 uF matched set, polycarbonate
C4	0.0018 uF capacitors
C5, C8	120 pF
C6	10 uF electrolytic capacitor
C7	1000 pF, disc capacitor
C9	0.1 uF disc capacitor
CR1, CR2	1N4001 rectifier diodes
CR3, CR4	1N914 switching diodes
F1	0.25 Amp slow-blow fuse
Q1	2N2907 transistor
R1	1000-Ohm wirewound potentiometer
R2	1000-Ohm trimmer potentiometer
R3, R4, R5, R10	5600-Ohm, ¼-Watt resistor
R6	3300-Ohm, ¼-Watt resistor
R7	100-Ohm, ¼-Watt resistor
R8, R9, R11	1000-Ohm, ¼-Watt resistor
R12	3400-Ohm 1%, 1/8-Watt, metal film resistor
R13	4020-Ohm 1%, 1/8-Watt, metal film resistor
R14	Trim-on-test, ¼-Watt resistor, approximately 1000 Ohms
S1	SPST slide switch
S2	DPDT slide switch
S3	1-pole, 4-position rotary swtich
S4	NO momentary push-button switch
T1	Power transformer, 115 V 60 Hz primary; 16 V c-t at 1.5 Amps secondary
U1	CD 4047AE oscillator
U2	74L00 low-power quad two-input NAND gate
U3	7403 open-collector quad two-input NAND gate
VR1	UA7805 IC voltage regulator
Misc.	Perforated circuit board, suitable enclosure, line cord, 5-way binding posts, control knobs, fuse clips, hookup wire, solder, hardware.

Construction Notes

Hardware assembly is relatively simple and is most easily accomplished using a 0.1" perforated circuit board. IC sockets with wire-wrap or solder tails can be used, and the wiring layout is not particularly critical at the frequencies involved. An aluminum sheet metal bracket may be attached to the circuit board to mount the various binding posts, switches, and controls. The IC regulator should also be directly mounted to this bracket, without insulator.

The frequency range capacitors must have a ±5% tolerance and must be matched to each other to 1 or 2% if good dial tracking between ranges is expected. R14 is selected such that the oscillator with R1 fully CCW is no higher than 0.9 of that range. Calibration potentiometer R2 is adjusted to yield a frequency of 12 at the full CW position of R1. The dial may then be linearly divided between 1 and 11.

For less ambitious readers, the instrument is available either in kit form or fully wired at $64.50 and $79.50, respectively, from Integral Electronics Corporation, PO Box 286, Commack NY 11725. ■

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Beer Sheva, Israel

Earl Rubin 4Z4TJ
12 Rotem St., Neve-Noy
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A New Type of 10 GHz Receiver

—use it or lose it

Amateur band utilization has shown a trend towards shorter and shorter wavelengths. In the near future, amateurs will probably be using the microwave region, either because its utilization will become more practical or in order to "save our spectrum" from the CBers.

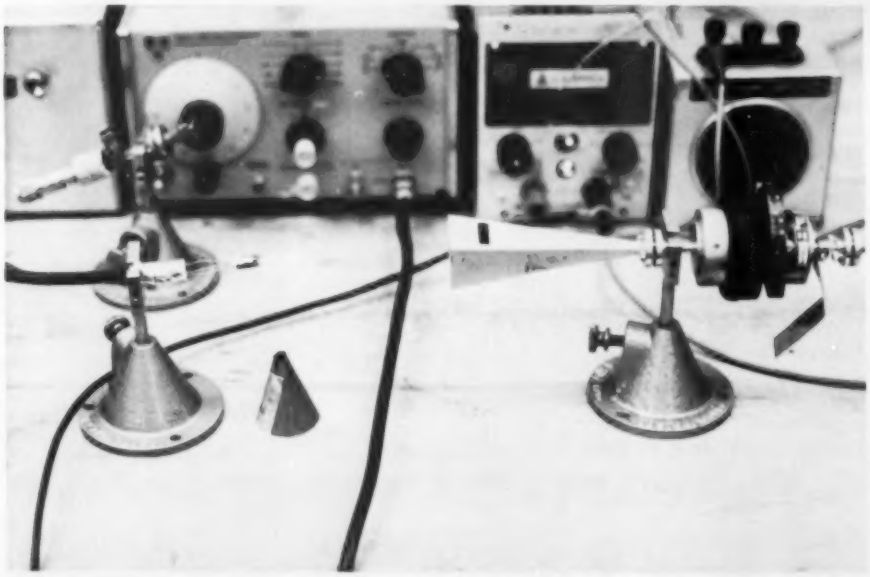
For most amateurs, a project involving microwaves probably conjures up visions of a silver-plated plumber's nightmare. Still, we occasionally get the urge to try out all those exotic klystrons, magnetrons, etc., bought over the years as *objects d'art* or to speculate on rising copper prices.

In all probability, your junk box now contains at least a few devices capable of performing credibly as microwave detectors. We are referring to the neon glow lamps commonly used as indicator lights.

In this article, we will provide data for experimenting with glow discharge detectors and outline their theory of operation. Basic information on working with microwaves is available from a number of good texts on the market.[1,2]

Conventionally, microwaves are detected by point contact crystal diodes appropriately mounted in waveguide fittings. These diodes are expensive and electrically delicate — two parameters which make them unsuitable for amateur experimenters. The advantages of glow lamps as detectors include low cost (less than $1 for most commercial tubes), wide dynamic range (cannot be damaged by accidental large bursts of incident power), electronic ruggedness, broad spectral range (the same tube can operate in both the microwave and millimeter wave regions), and the ability to operate at relatively high temperatures and incident power levels. Glow-lamp detectors are simple to use (no refrigeration or magnetic fields required) and have the ability to play the role of receiving antenna and transducer simultaneously.[3]

Fig. 1 shows the basic setup for experimenting with glow-lamp detectors. The power supply should be well regulated and have a low noise level. The glow tube is positioned in front of the radiation source and connected through a preamplifier to an oscilloscope. The radiation source should be modulated with a function generator or mechanical chopper (fan with metal blades). The bias on the glow tube should be adjusted to a value appropriate to the particular tube you are using. Table 1 lists almost all the common types.[4] Fig. 2 shows typical detector responsivity (R) plotted against discharge current (I).[4] Sensitivity is affected by orientation of the lamp in the microwave field. In addition, the diameters of the lamps are about three times the electrode separation — the sensitive detecting area is, therefore, a small part of the lamp cross section. Radia-



Experimental test setup.

tion can be focused on the plasma between the electrodes with inexpensive conducting cones of sheet metal or Plexiglas™ covered with conducting paint.[5] Such homemade antennas, if focused properly on the sensitive plasma volume, make much more efficient use of the lamp cross-sectional area.

The mode in which a glow detector operates is quite simply explained. The gas is partially broken down with a dc source (as in Fig. 1). The microwave electric field enhances random electron velocity and, thus, the ionization collision rate of electrons with neutral atoms in the glow discharge plasma. The microwave envelope is detected as changes in discharge current, which can then be capacitor coupled to an amplifier.

Glow lamps can also be used as heterodyne detectors. The thermal sensitivity of crystal diodes usually limits the local oscillator power to an average of 10-20 mW or less. The diode is easily damaged by incident power levels greater than 50 mW. Glow discharge detectors can absorb power levels many orders of magnitude higher.

Because of their electronic ruggedness and large dynamic range, glow discharge detectors are capable, in principle, of being used with very large local oscillator powers and, thus, of detecting very low signal levels. Even with the local oscillator powers normally used in mixers designed for diodes, the sensitivity available with common, inexpensive, neon glow lamps is quite comparable, if not superior, to that achievable with diode detectors in heterodyne detection.

Another advantage of diode detectors is that the high sensitivity is achieved despite the high noise level, as a result of very high responsivity. This means that no special low-noise amplifier or similar equipment is required. A low-ripple power supply is, however, desirable. Rise times

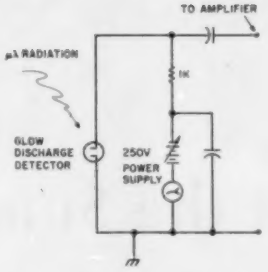


Fig. 1. Glow discharge detector biasing circuit.

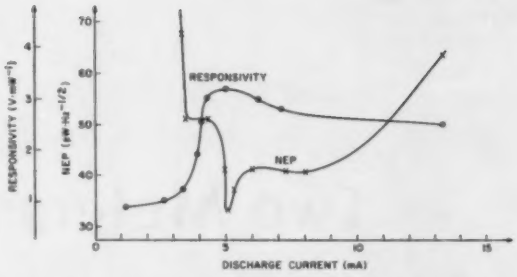


Fig. 2. Responsivity and NEP for X-band radiation as a function of discharge current (I) in the NE-84 glow lamp.

in commercial glow lamps are on the order of a microsecond.[4] This limitation probably stems from reactance due to lamp construction, and not from the physics of the detection mechanism. The microsecond rise time limits the intermediate frequency to less than a megahertz – a limitation which may require PLL stabilization of the local oscillator in a practical receiver.

Table 1 shows the results of a survey of commercially-available glow tubes at X-band (10 GHz).[4] The best detection results for each tube are compared with typical values for diode detectors. The glow tubes are listed by NEP. NEP is defined as minimal detectable signal power (occurs at unity signal-to-noise ratio) per square root of bandwidth. V_n is the noise voltage over a 10 kHz-100 kHz bandwidth; A_r is the detecting area of the glow lamp; R is the glow lamp response per unit microwave power. To maximize A_r, the lamps were oriented with the electrode plane parallel to the microwave electric field and perpendicular to the microwave energy flow. In this case, A_r is the plasma area between the electrodes.

Glow lamps may also be used to detect optical (light) radiation.[6] ■

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2. E. L. Jordan and K. G. Balmain, ***Electromagnetic Waves and Radiating Systems,*** New Delhi, Prentice-Hall of India, Ltd., 1969.
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5. N. S. Kopeika, "Millimeter-Wave Holography Recording with Glow Discharge Detectors," ***Int. J. Electronics,*** Vol. 38, pp. 609-613, May, 1975.
6. Kopeika, ***et al, Applied Optics,*** June, 1976, pp. 1610-1615.

Tube	V_n (uV)	I (mA)	R(V·mW^{-1})	NEP(pW·Hz$^{-½}$)	t_r (us)
A059-2	40	2	4.45	1.44	2.1
NE-4	46	3	3.69	2.17	3.0
NE-76	50	3	3.10	2.23	2.0
NE-3	39	3.4	3.81	6.20	2.4
NE-7	57	40.0	3.29	6.59	4.5
AR-9	84	2.5	4.26	7.51	2.5
NE-51-H	21	1.8	0.09	9.82	4.0
5AB-A	57	8.0	4.24	9.86	10.0
5AB-B	54	13.0	2.86	11.0	2.3
5AB	57	12.0	4.11	11.4	2.4
NE-81	73	15.0	3.67	15.9	2.0
A059-9	57	8.0	3.31	24.5	2.1
5AH-D	46	6.5	1.92	28.2	2.4
NE-2U	77	17.0	1.67	29.8	1.4
NE-84	137	4.2	2.32	30.7	1.0
AIB	72	17.0	4.46	34.9	0.8
5AHA	40	4.5	3.07	37.6	1.6
5AH	54	15.0	1.98	39.4	2.0
TRJ250	10	I_1 = 2, I_2 = 0.5	0.50	39.5	2.5
AIC	70	12	9.00	41.1	2.0
1N238 crystal* diode (Sylvania)	7		211.0	0.318	–
MA-40207 Schottky-barrier diode	–	0.02	5.0	1.1	–

*parameters measured in test setup.

Table 1. Glow discharge tube and diode sensitivities to X-band radiation. I is current, and t_r is rise time.

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Pacific Palisades CA 90272

Two Meters At the Summit

—a backpacker's delight

In many years of going on backpacking or peak-bagging jaunts in wilderness areas of western mountains, I have often thought of how vulnerable I (if alone) or fellow mountaineers would be if something went drastically wrong. Usually, we would be miles from the nearest roadhead and then additional road miles from a source of help like a ranger station or a sheriff's office.

Taking along a 2 meter handie-talkie for use in emergency communications is a likely solution if there are other stations available for communication. It wouldn't increase the overall weight of a knapsack or a backpack by a great deal. And, further, it might even make things more pleasurable, using it to talk to fellow hams from camps, from rest spots along the trail, or from peaks.

In the spring of 1976, I finally succumbed to the VHF rage and acquired a Wilson 2-Watt handie-talkie (1402SM). After putting it to use in many enjoyable contacts around the Los Angeles area, I decided to try it out on some mountaineering jaunts. It was used on four peak-bagging trips during the summer of 1976, and I thought the consequences would be of some interest.

The HT got its first such initiation on July 14, 1976, when I joined a group of about 25 Sierra Club members for a day hike to the top of Mt. Waterman (8,038 feet elevation) in the nearby Angeles National Forest. I had removed and left at home the rubber ducky antenna and connected a retractable quarter-wave whip in its place.

At the start of the hike, I made my first mistake. I put the HT rig in my knapsack with the antenna protruding upwards a bit. That was unfortunate because, about two-thirds of the way to the peak, it got snagged by a low overhanging tree branch and broken off at its base. On reaching the peak, all I was able to do was hold the antenna in place and listen — and stations were coming in from all over southern California. This painful experience pointed out what I should have done and did thereafter. The whip antenna was disconnected when being transported and placed along with the rubber ducky as a spare in a small plastic bag held by rubber bands to the body of the HT. Also, a small notebook and a pencil with a clip were added for record-keeping purposes. In addition, a spare set of alkaline batteries was carried along, wrapped in another plastic bag.

The second use was on a backpacking trip in the Mt. Whitney region of California's High Sierra mountains. I was the leader for a group of 16 who started at the Whitney Portal roadhead (8,300 ft.) and backpacked to a base camp at Consultation Lake (11,700 ft.). From both locations, I was able to talk with stations in Owens Valley via 52 simplex and via the .34/.94 Bishop repeater (WR6ACG). Excessive rains made things rather miserable, but, finally, July 28 dawned bright and clear, so 15 of us started for the big peak (Mt. Whitney at 14,495 ft., the highest mountain in the "lower 49" states).

As the day progressed, the weather got worse. By the time we got to the top, we

The author operating his HT from an excellent location in the High Sierra.

had experienced heavy rain, hail, lightning, and snow. But all 15 made it to the peak.

On the summit is an old two-room concrete-block hut which was originally used as a Smithsonian observatory. After a hurried lunch inside it, I rigged up the whip on the HT and, just outside the hut, made a few contacts via the Bishop repeater. While talking to a station in Bishop, I suddenly got a sharp shock from the charged clouds nearby and thereafter operated from inside the hut under the protection of a corrugated metal ceiling. The copy was equally good from there.

I next tried to contact some stations using the .34/.94 Fresno machine (WR6ACU). From their conversations, it was obvious they were hearing me, but they elected to continue their own QSO talking about diodes on the repeater's input circuit and such. Then I shifted to .22/.82 and heard a fellow in Santa Maria and talked to him via the San Luis Obispo repeater (WR6AEL) 186 miles away. When we finished, an old friend gave me a call from Baywood Park, and we had a nice chat. About this time, the lightning was getting a little too close, so I buttoned things up and headed back down to camp. The jaunt down was rather precarious on the snow and over parts of the route that had been washed out. But, fortunately, we all made it, and the HT didn't have to be used for any emergency purposes.

A couple of weeks later, my wife and I were camping in the Medicine Bow National Forest of southern Wyoming when I decided to hike to the high point of the Snowy Range, Medicine Bow Peak (12,013 ft.). The jaunt up to the peak on August 20 was rather invigorating and rocky and was rewarded with a wonderful view and an excellent location for 2m QSOs. Via the .22/.82 repeater in Laramie (WR7ADP), I talked to stations in Cheyenne and in Laramie. Via the .34/.94 repeater in Laramie (WR7ADK), I contacted additional stations in Laramie. Then also on .34/.94, I talked to a station in the Big Horn Mountains through the Casper machine (WR7ADR). I tried to break the .34/.94 repeater in Denver, but it was apparently too far away.

My fourth and last peak-bagging trip was on September 1 in the northern part of the High Sierra while camping with some of my family. I started at the Tioga Pass Ranger Station (9,946 ft.) and hiked and boulder-hopped to the top of Mt. Dana (13,053 ft.). Here again there was a terrific view and a super location for 2m operation. Being very high on the main crest of the High Sierra, I was able to break three repeaters simultaneously on .34/.94: the WR6ACG machine in Bishop, the WR6ACU machine in Fresno, and the WR6ADF machine at Oakland in the San Francisco Bay area. It was sometimes difficult to tell which repeater was being used for the QSOs I had with stations in Modesto, Davis, Alameda, Novato, and Owens Valley. Some of these contacts were also duplicated on .52 simplex, notably with a fellow in Novato, at a distance of 218 miles. In addition, I tried .22/.82 and, through the Oakland repeater (WR6ABM), contacted another station in Novato and one in Concord. One of the .34/.94 QSOs was a pleasant surprise, with a fellow in Bishop I had previously contacted from Mt. Whitney.

I thoroughly enjoyed these experiences with my reliable HT and recommend that others give it a try. Fortunately, there were no emergencies to report, but it does give one a feeling of security. ■

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Social Events

from page 219

the Heritage House Smorgasbord, 8209 N. Mt. Hawley Rd., at 7 pm on Saturday, September 16, for $4.25 per person. 2 meter talk-in on 146.7-6; just call W9UVI. Local repeaters are .16-.76, .25-.85, and .37-.97. For information, write to John Sutton WD9BJJ, 608 W. Teton Drive, Peoria IL 61614, phone (309)-691-7073.

HARRISBURG PA
SEP 17

The Central Pennsylvania Repeater Association will hold the fifth annual Electronic Swap Fest and Hamfest on Sunday, September 17, 1978, beginning at 8:00 am, at the Park-n-Shop Parking Garage (Center City), 200 Block Walnut Street, Harrisburg, Pennsylvania. This is a rain or shine event with indoor parking for 1100 cars. Registration is $3.00 and wives and children are free. Food and refreshments are available. Talk-in on 146.16/.76, 146.34/.94, and .52 simplex. For more information, contact WB3HXH (717)-944-7017.

VENICE OH
SEP 17

The Cincinnati Hamfest will be held on Sunday, September 17, 1978, at Stricker's Grove, State Route 128, Venice (Ross), Ohio. There will be exhibits, prizes, a flea market, a hidden transmitter hunt, and a sensational air show. Tickets are $7.50 in advance; $8.00 at the gate. For complete information, contact the Greater Cincinnati Amateur Radio Association, c/o John P. Haungs WA8STX, Treasurer, 10615 Thornview Drive, Evendale OH 45241.

NORFOLK VA
SEP 23-24

Tidewater Radio Conventions, Inc., is pleased to announce its third annual hamfest, flea market, and computerfest to be held on September 23 and 24 at the Norfolk Cultural and Convention Center (SCOPE). This is an approved ARRL function. Large indoor, air-conditioned facilities for flea market and exhibitors. Tickets are $2.50 by September 16 and $3.50 at the door. Tailgaters' tickets are $5.00 per day and $7.50 for two days, in advance, and $6.00 at the gate. For details, contact Norman V. Cohen WB4LJM, Box 9371, Norfolk VA 23505.

ERIE PA
SEP 24

The third annual HamJam, sponsored by the Radio Association of Erie, will be held on Sunday, September 24, 1978, from 9:00 am to 4:00 pm, at Waldameer Park in Erie, Pennsylvania. Admission is $1.50 in advance; $2.00 at the gate. There will be refreshments and prizes. Talk-in on 34/94, 22/82, and 52. For complete info, write HamJam '78, Radio Association of Erie, Box 844, Erie PA 16512.

ADRIAN MI
SEP 24

The Adrian Hamfest will be held on Sunday, Spetember 24, 1978, at the Lenawee County Fairgrounds, Adrian, Michigan. There will be a computerized ham radio station and a communications satellite seminar presented by Dr. Ralph E. Taggart WB8DQT. Prizes include an Icom IC-22S, a Bird 43 wattmeter, and a Heathkit HW-8. Tickets are $1.50 in advance; $2.00 at the gate. Tables are $4.00 for full table; $2.00 for half table. Trunk sales are $1.00 per space. Talk-in on 146.31/.91 or 146.52 (W8TQE). For complete information, contact the Adrian Amateur Radio Club, Inc., PO Box 26, Adrian MI 49221, or phone (517)-265-8016.

VALPARAISO IN
SEP 24

The Valpo Tech Alumni Association will hold its annual hamfest on Sunday, September 24, 1978, on the campus of Valparaiso Technical Institute. Admission to the event is $2.00 for both visitors and exhibitors. For further information and directions, write Hamfest, Valpo Tech Alumni Association, Box 490, Valparaiso IN 46383, or phone (219)-462-2191.

NEW BERLIN IL
SEP 24

The Sangamon Valley Radio Club of Springfield, Illinois will hold its third annual hamfest on Sunday, September 24, 1978, at the Sangamon County Fairgrounds, New Berlin, Illinois. There will be an indoor exposition building with no charge to set up. Overnight camping available for Saturday night. Food and refreshments will be available on the grounds. WA4WME, of the recent Clipperton Atoll DXpedition, will give his slide and movie presentation. There will be lots of other activities, including those for ladies and children. For further information, contact Richard I. Osland K9FNB, Publicity Chairman, 1025 South 6th Street, Springfield IL 62703.

GAINESVILLE GA
SEP 24

Lanierland Amateur Radio Club will hold its fifth annual HAMNIC at the Lanier Islands Dogwood Pavilion on September 24, 1978. There are two large covered pavilions and a large parking area for the swap shop and exhibits. First prize is a KDK FM2015R along with many other prizes. Food available. No entry fee for HAMNIC, but Lanier Islands charges $2.00 entry fee per car. Picnic, hiking and swimming for the kids. Talk-in on .07/.67. For further information, write Bob Cochran W4DNX, 607 East Lake Drive, Gainesville GA 30501.

FLINT MI
SEP 24

The Greater Genesee Valley Amateur Radio Club, in conjunction with the Bay Area Amateur Radio Club, Genesee County Radio Club, Lapeer County Amateur Radio and Repeater Club, Saginaw Valley Amateur Radio Association, and the Shiawassee Amateur Radio Association, presents a Five County Swap-n-Shop at 1420 W. 12th St. On I-69, south, take Hammerberg Rd. off and turn left at 12th St. Tickets are $2.00 per person and $3.00 per family. Tables available. Talk-in on 147.27, 146.91, and 146.52. For more information, write to Five County Swap-n-Shop, Box 7671, Flint MI 48507.

CORPUS CHRISTI TX
SEP 30

The Corpus Christi ARC and the South Texas Amateur Repeater Club will hold a South Texas Swapfest on Saturday, September 30, 1978, 9:00 am to 5:00 pm, at the Texas National Guard Armory, 1430 Horne Rd., Corpus Christi, Texas. Admission and tables are free. There will be dealer displays, contests, and door prizes. Talk-in on .34/.94 and .28/.88. For additional information, contact J. E. Rehler W5KNZ, 526 Pasadena, Corpus Christi TX 78411.

ELMIRA NY
SEP 30

The third annual Elmira Amateur Radio Association Hamfest will be held at the Chemung County Fairgrounds on September 30. Gates open at 9:00 am. A grand prize and several door prizes will be offered. No extra charge for flea market space. Indoor space available on a first come, first served basis. Several dealers will also be on hand with their displays. Talk-in on 146.52/52, 146.10/70, and 147.96/36. For advance ticket sales and further info, contact John Breese WA2FJM, 340 West Ave., Horseheads NY 14845.

WILLOW GROVE PA
SEP 30

The second annual Mid-Atlantic States VHF Conference will be held on Saturday, September 30, 1978, at the Treadway Inn on Easton Rd. (Route 611, Exit 27 of the PA turnpike), Willow Grove, Pennsylvania, on the day before Hamarama 78. The conference will be an all-day VHF program moderated by prominent VHFers. For advance registration, contact Ron Whitsel WA3AXV, Chairman, PO Box 353, Southampton PA, 18966; (215)-355-5730. Indicate motel registration forms required.

GRAYSLAKE IL
SEP 30-OCT 1

Radio Expo '78 will be held on Saturday and Sunday, September 30 and October 1, 1978, at the Lake County Fairgrounds, Grayslake, Illinois. The fairgrounds are located at Routes 45 and 120. The convention center is at the Mundelein, Illinois, Holiday Inn. There will be dozens of manufacturers' and distributors' exhibits, indoor and outdoor flea market areas, seminars, and free camping. The flea market will be open Friday for setup. Tickets are $2.00 in advance; $3.00 at the gate. Talk-in on .16/.76. For details, write Radio Expo '78, PO Box 305, Maywood IL 60153.

LOUISVILLE KY
SEP 30-OCT 1

The eighth annual Greater Louisville ARRL hamfest will be held on Saturday, Sept. 30, and Sunday, Oct. 1, at the West Hall of the Kentucky Fair and Exposition Center. There will be a gigantic indoor air-conditioned exhibitor's area and flea market with meetings and forums and ladies' programs both days. Admission is $3.00 for adults with children 12 years and under free. Flea market vendors pay admission plus $3.00 per space for one day only, or $5.00 per space will cover both days. Camping is available on the grounds, free with no hookup. For more information contact Denny Schnurr K4GOU, 2415 Concord Drive, Louisville KY 40217, phone (502)-634-0619.

WEST GHENT NY
OCT 8

The Northeastern States 160 Meter Amateur Radio Association will hold its annual banquet on Sunday, October 8, 1978, at Kozel's Restaurant, West Ghent, New York. A roast beef dinner will be served at 6:00 pm. Cost is $8.00 per person. From 1:00 pm to 4:00 pm there will be a flea market. Cocktail hour is from 4:00 pm till dinner time.

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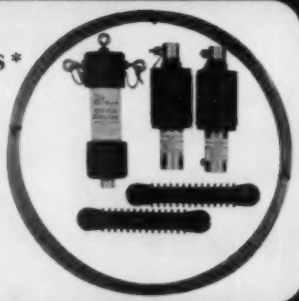

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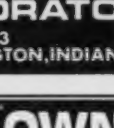

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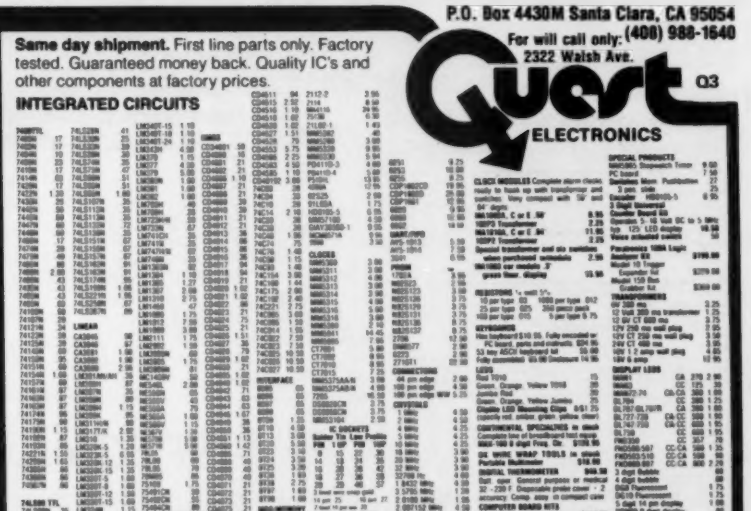

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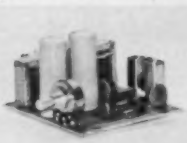

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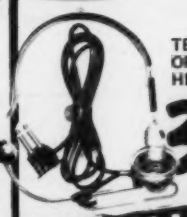

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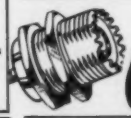

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ELECTRET SHOTGUN MICROPHONE!

SPECIAL!

59.95

15 INCHES LONG!

Amazing Directional Characteristics—very similar to studio models selling for 5 times our low price! 20-20,000 Hz, 600 ohms. This is a professional mike, designed for TV studio use. Superb, carefully selected electret cartridge powered by 1.5V pencell solves all requirements of sharp directivity, wide response, startling sensitivity - even at 50 feet! With windscreen, cable, stand clamp. (2 lb.) 037MP112

SWITCHCRAFT MIKE CONNECTORS!

SEPTEMBER SPECIAL!

037MS337	3P male (A3MX3 oz.)	$1.49
037MS251	3P female (A3F)(3 oz.)	$1.69

6500 in stock!

SURPLUS SALE!

16-PIN IC SOCKETS!

19¢

SPECIAL OF THE MONTH! Short "spring claw" pins for PC board mount. High profile. (Berg No. 6). Brand new factory surplus. (1 oz.) 037JK155

24 HOUR- 7 DAY-A-WEEK TELEPHONE ORDER SERVICE! Call in your chargecard orders at low weekend and evening rates: DIAL: 1–518–561–8700.

E31

DEALER INQUIRIES INVITED

FREE SURPLUS CATALOG!

No. AA catalog. Packed with electronic bargains and unusual items! Write or circle the information card number below.

ETCO ELECTRONICS LIQUIDATORS OF EXCESS ELECTRONIC INVENTORIES

T.M.

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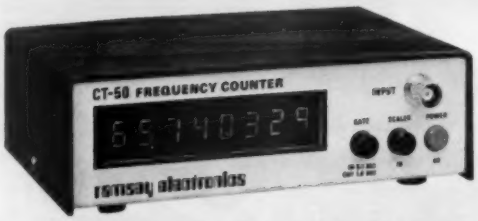
ETCO ELECTRONICS CORP. U.S.A.
North Country Shopping Center,
Route No. 9, Plattsburgh, N.Y. 12901

MERCHANDISE SUBJECT TO PRIOR SALE. Full remittance with each order, please. Money Order, Certified check, BANKAMERICARD, VISA, MASTERCHARGE or CHARGEX. Add 15% for UPS (or postage and handling (we refund excess). Please try to bring your order total to $10 or more. Worldwide export orders solicited. Open account to Government agencies, schools, institutions and triple "A" rated industrial & commercial accounts. Special quotes for quantities. N.Y. state residents: add 7% sales tax.

NEW Frequency Counter

$89.95 kit



UTILIZES NEW MOS-LSI CIRCUITRY

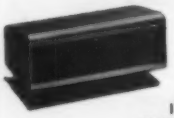
You've requested it, and now it's here! The CT-50 frequency counter kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 V dc as it does on 110 V ac. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $89.95. Order yours today!

CT-50, 60 MHz counter kit ..... $ 89.95
CT-50 WT, 60 MHz counter, wired and tested 159.95
CT-600, 600 MHz prescaler option for CT-50, add 29.95

SPECIFICATIONS
Sensitivity: less than 25 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 2.0 ppm, .001 ppm with TV time base!
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy

CB-1, kit $14.95



CLOCK KIT
6 digit 12/24 hour

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, bronze, blue (specify).

Clock kit, DC-5 ..... $22.95
Alarm clock, DC-8, 12 hr only 24.95
Mobile clock, DC-7 ..... 25.95
Clock kit with 10 min ID timer, DC-10 ... 25.95
Assembled and tested clocks available, add $10.00

VIDEO TERMINAL KIT $149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard operated curser and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor. Keyboard/computer control backspace, forward spaces, line feeds, rev. line feeds, home, returns curser. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit $149.95
TH3216, Assembled and Tested 239.95
VD 1, Video to RF Modulator Kit 6.95

CAR CLOCK KIT $27.95

12/24 Hour 12 Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo .4" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 ..... $27.95

AUTO-DIMMER $2.50
Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock.

MINI-KITS

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 ..... $4.95

SUPER SLEUTH AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 ..... $4.95

FM WIRELESS MIKE KIT
Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9 V. Type FM-2 has added super sensitive mike preamp.
FM-1 ..... $2.95 FM-2 ..... $4.95

COLOR ORGAN/MUSIC LIGHTS
See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 ..... $7.95

LED BLINKY KIT
A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.
Complete Kit $2.95

POWER SUPPLY KIT
Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 80 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.
Complete Kit, PS-3LT $6.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 ..... $2.95

DECADE COUNTER PARTS
Includes: 7490A, 7475, 7447, LED readout, current limit resistors, and instructions on an easy to build low cost frequency counter.
Kit of parts, DCU-1 ..... $3.50

CHEAP CLOCK KIT $8.95

DC-4 Features:	Does not include board or transformer	PC Board $2.95 Transformer $1.49

- 6 digit .4" LED
- 12 or 24 format

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. Specify ÷10 or ÷100
Wired, tested, PS-1B $89.95
Kit, PS-1B $44.95

30 watt 2 meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, incredible value, complete with all parts, instructions and details on T-R relay. Case not included.
Complete Kit, PA-1 ..... $22.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!
FEATURES:
- 6 Digits, .5" High LED
- Calendar shows mo./day
- True 24 Hour Alarm
- Battery back up with built-in on chip time base
- 12/24 Hour Format
- Snooze button
- 7001 chip does all!!

Complete Kit, less case, DC-9 ..... $34.95

8314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
74S00	.35	556	.75	309k	.89	NPN 2N3904 type	10/$1.00
74S112	.75	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K-12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.65	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A ..... 5/$1.00 100V,1A ..... 10/$1.00 1N914A type ..... 50/$2.00

LED DISPLAYS

FND 359 ..... .75
FND 510 ..... 1.25
DL 707 ..... 1.25
HP 7730 ..... 1.25
Red Polaroid Filter ... 4.25" X 1.125" .. 59

741 OP-AMP SPECIAL
Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

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with info and specs
15/$1.00
6 hole Balun Beads
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Satisfaction guaranteed or money refunded. COD, add $1.00. Orders under $10 add $.75. NY residents add 7% tax. Add 5% for postage, insurance, and handling. Minimum order $9.00.

R8

NEW FM/CW EXCITER KITS

BUILD UP YOUR OWN GEAR FOR MODULAR STATIONS, REPEATERS, & CONTROL LINKS
● Rated for Continuous Duty ● Professional Sounding Audio ● Built-in Testing Aids

T50 Six Channel, 2W Exciter Kit for 2M, 6M, or 220 MHz $49.95

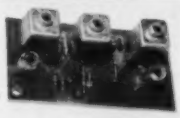
FAMOUS HAMTRONICS PREAMPS

let you hear the weak ones!

Great for OSCAR, SSB, FM, ATV. Over 10,000 in use throughout the world on all types of receivers.

P9 Kit $12.95
P14 Wired $24.95

Deluxe vhf model for applications where space permits.



●1-1/2 x 3" ●Covers any 4 MHz band ●12 Vdc ●Ideal for OSCAR ●Diode protection ●20dB gain

MODEL	RANGE
P9-LO	26-88 MHz
P9-HI	88-172 MHz
P9-220	172-230 MHz
P14 Wired	Give exact band

P8 Kit $10.95
P16 Wired $21.95

Miniature VHF model for tight spaces - size only 1/2 x 2-3/8 inches.

●Covers any 4 MHz band ●20 dB gain ●12 Vdc

MODEL	RANGE
P8-LO	20-83 MHz
P8-HI	83-190 MHz
P8-220	220-230 MHz
P16 Wired	Give exact band

P15 Kit $18.95
P35 Wired $34.95

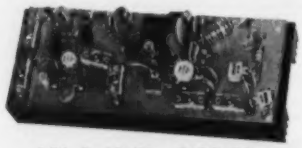
●Covers any 6 MHz band in UHF range of 380-520 MHz ●20 dB gain ●Low noise

YOU ASKED - HERE THEY ARE!

VHF Linear PA's

● Use as Linear or Class C PA's ● For XV-2 Xmtg Converters, T50 Exciters, or any 2W Exciter

LPA 2-15 Kit $59.95
● 15W out (linear) or 20W (class C) ● Solid State T/R Switching ● Models for 6M, 2M, or 220 MHz

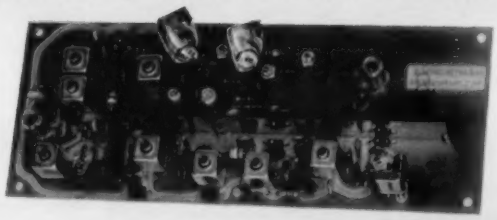


LPA 2-45 Kit $109.95
● 45W out (linear) or 50W (class C)
● Models for 6M or 2M

LPA 8-45 Kit $89.95
For 2M, 8-10W in, 45W out

AT LAST! 6M, 2M,& 1¼M
SSB TRANSMITTING CONVERTERS
At a price you can afford

Use inexpensive recycled 10 or 11 meter ssb exciter on VHF bands!



FEATURES:
- Linear Converter for SSB, CW, FM, etc.
- A fraction of the price of other units
- 2W p.e.p. output with 1 MW of drive
- Use low power tap on exciter or attenuator pad
- Easy to align with built-in test points

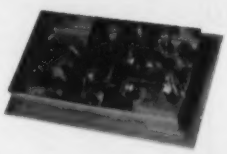
XV2-( ) TRANSVERTER KIT $59.95
A25 Optional Cabinet for Xverter&PA $20

Frequency Schemes Available:

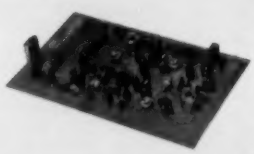
XV2-1	28-30 MHz =	50 - 52 MHz
XV2-2	28-30 MHz =	220-222 MHz
XV2-4	28-30 MHz =	144-146 MHz
XV2-5	28-29 MHz =	145-146 MHz
XV2-6	26-28 MHz =	144-146 MHz

New VHF&UHF Converter Kits

let you receive OSCAR signals and other exciting SSB, CW,& FM activity on your present HF receiver.



either one
-ONLY $34.95
including crystal



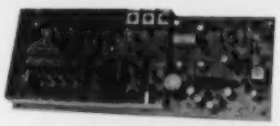
MODEL	RF RANGE (MHZ)	I-F RANGE
C50	50-52	28-30
C144	144-146	28-30
C145	145-147 (OSCAR)	28-30
C146	146-148	28-30
C110	Aircraft	28-30
C220	220 band	28-30
Special	Other I-f & rf ranges available	

MODEL	RF RANGE (MHZ)	I-F RANGE
C432-2	432-434	28-30
C432-5	435-437(OSCAR)	28-30
C432-7	427.25	61.25
C432-9	439.25	61.25
Special	Other I-f & rf ranges available	

A9 Extruded Alum Case/Connectors $12.95

VHF/UHF FM RCVR KITS

★ NEW GENERATION RECEIVERS
★ MORE SENSITIVE ★MORE SELECTIVE (70 or 100 dB)
★ COMMERCIAL GRADE DESIGN
★ EASY TO ALIGN WITH BUILT-IN TEST CKTS
★ LOWER OVERALL COST THAN EVER BEFORE



R70 6-channel VHF Receiver Kit for 2M, 6M, 10M, 220 MHz, or com'l bands..... $69.95
Optional xtal filter for 100 dB adj chan 10.00

R90 UHF Receiver Kit for any 2 MHz segment of 380-520 MHz band..... $89.95

✱FREE 1978 CATALOG✱

NEW JUNE 1978 CAT. IS YOURS FOR THE ASKING!

IT'S EASY TO ORDER!

- CALL OR WRITE **NOW** FOR **FREE** CATALOG OR TO PLACE ORDER!
- PHONE 716-663-9254. (Answering service evenings and weekends for your convenience. Personal service 9-5 eastern time.)
- Use credit card, c.o.d., check, m.o.
- Add $2.00 shipping & handling.

IN CANADA, send to Comtec; 5605 Westluke Ave; Montreal, Que H4W 2N3 or phone 514-482-2640. Add 38% to cover duty, tax, and exchange rate.

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BULLET ELECTRONICS

P.O. Box 19442E Dallas, TX. 75219 (214)823-3240

MC3301P HOUSE #

4 OP AMPS IN ONE PACKAGE. USES SINGLE SUPPLY, (4 to 28VDC). INTERNALLY COMPENSATED. SIMILAR TO MC3401, BUT HIGHER GAIN. **49¢**

MC1437P DUAL 709 OP AMP

HIGH OPEN LOOP GAIN, LOW NOISE. 14 PIN DIP **3/1.00**

MC1351P FM-IF AMP AND DISCRIMINATOR

USED IN FM & TV SOUND CIRCUITS. REQUIRES MINIMUM EXTERNAL COMPONENTS. 14 PIN DIP. DIRECT REPLACEMENT FOR HEPC 6060, ECG 748 and MANY OTHERS. HOUSE # **WITH SPECS** **50¢**

HOUSE #

LM3900 QUAD NORTON AMP

WE BOUGHT A LARGE QUANTITY OF THESE HOUSE NUMBERED PARTS AT A BARGAIN PRICE THAT ALLOWS US TO SELL THEM AT A LOW, LOW **39¢**

TIL312 COMMON ANODE READOUT

3" CHARACTER SIZE WITH PINOUT **.65** **6/3.00**

MPF131 N-CHANNEL DUAL GATE MOSFET

50¢

DESIGNED FOR AMPLIFIER AND MIXER APPLICATIONS TO 200 MHZ. PLASTIC CASE. UNITS ARE HOUSE NUMBERED **WITH SPECS.**

IL-1 OPTO ISOLATORS

BY LITRONIX 6 PIN DIP STANDARD PINOUT LED-TRANSISTOR COMBINATION. **50¢** ***WHILE THEY LAST!***

SMALL SKIRTED BLACK INSTRUMENT KNOB.

FITS ¼" SHAFT WITH SET SCREW. **5/1.00**

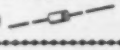
MJ900 - MJ1000

COMPLIMENTARY PNP, NPN **DARLINGTON POWER TRANSISTORS.** 8 AMPS. WE SUPPLY A SCHEMATIC TO BUILD A HIGH POWER (35W) LOW DISTORTION AUDIO AMP WITH ONLY ONE ADDITIONAL TRANSISTOR AND A DOZEN INEXPENSIVE COMPONENTS! TO-3 CASE STYLE **BUY A PAIR FOR**

$3.00!

1N4148 DIODES

LEADS ARE TARNISHED BUT CLEAN UP EASILY. THE BOSS SAYS ***"DUMP 'EM"***...SO CHECK THIS PRICE! **50/1.00**



HOUSE # PNP POWER

TO-3

150 WATTS
80 VCEO
10 AMPS

IDENTICAL TO 2N3790 **1.00**

MC1469R POSITIVE VOLTAGE REGULATOR

½ AMP COMPLETE SPECS AND APPLICATIONS SHOW HOW TO BUILD FIXED OR VARIABLE POWER SUPPLIES FROM 3 TO 30VDC. DRIVE EXTERNAL SERIES PASS FOR CURRENT TO 20 AMPS!

1.25 EA.
10/10.00
HOUSE #

FANTASTIC SOUND EFFECTS CHIP

AVAILABLE ONLY FROM BULLET!

THIS 28 PIN MARVEL CONTAINS A LOW FREQUENCY OSCILLATOR, VCO, NOISE OSCILLATOR, ONE SHOT, MIXER AND ENVELOPE CONTROL. WITH 8 PAGE MANUAL. 5 to 9VDC **3.95**

ALL COMPONENTS 100% GUARANTEED

CA3011	WIDEBAND IF AMP w/specs	50¢
2N3569	NPN EPOXY 1W	6/1.00
741	OP AMP 8 PIN DIP	5/1.00
723	VOLTAGE REG. 14 PIN DIP	50¢
MPS6530	NPN HOUSE #	8/1.00
725	OP AMP LOW NOISE HOUSE #	99¢
7815	15V 1A REGULATOR HOUSE #	69¢
LM340T-12	12V 1A VOLT. REG. w/specs	75¢
TCA430	QUAD OSCILLATOR 1/specs	69¢
2N4343	P CHANNEL J FET	4/1.00
2N6111	PNP MED PWR 40W TO-220	3/1.00
2N6028	PROGRAMMABLE UNIJUNCTION w/specs	50¢
TRIAC	200V 8A UNMARKED	3/1.00

INCANDESCENT PANEL LAMP

WITH TINNERMAN NUT YOUR CHOICE OF RED, GREEN, YELLOW, WHITE 12-24VDC **15¢**

POWER SUPPLY METERS

Quality 3½" meters for the P-S14, 0-18VDC & 0-25A. Matched set, individually packaged. NOT SURPLUS! **12.95/set**

CAPACITORS

SMALL SIZE!

2200 MFD @ 16 VDC RADIAL **3/1.00**
500 MFD @ 35VDC **5/1.00** AXIAL
220 MFD @ 25VDC **7/1.00** AXIAL
.1 MFD @ 20VDC DISC CERAMIC **15/1.00**

FND510 69¢

COMMON ANODE READOUT ½" CHARACTER
LIMIT 24 PER CUSTOMER!

Miniature 7K Pot w/certain PC Mount or panel mount 1/8" shaft 49
Black plastic knob for above PNOS

LIMITED QTY Computer Grade FILTER CAP Screw Terminals 2" X 5½" 9000 mfd@75V 5.95 or 4/$5.00

New! ULTRASONIC SENDER RECEIVER KIT US-02

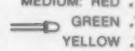
TOTAL SECURITY! Completely invisible ultrasonic (23KHZ) Sound beam works like a photoelectric beam but is unaffected by light, heat or noise. Separate Transmitter and Receiver can be used from 6 inches to 35 feet! A solid object breaking the beam causes an output to go low that will sink up to 100 MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100 MA. Use it for **burglar alarms, object counters, automatic door openers, automatic door bells, electronic rat trap(?) and more.**

COMPLETE KIT LESS CASES **21.50**

Optional entry delay and Alarm Timeout Circuit will source or sink up to 200 MA DC. **3.95**

LED'S JUMBO: RED **5/.89** GREEN **4/.89**

MEDIUM: RED **.15** MINI: RED **.10**
GREEN **.16**
YELLOW **.16**



1.5V 10-30 ma

POWER SUPPLY KIT PS-14

- Better than 200MV load and line regulation
- Foldback Current Limiting
- Short Circuit Protected
- Thermal Shutdown
- Adjustable Current Limiting
- Less than 1% ripple.
- 16 amps 11.5 to 14.5V
- All parts supplied including heavy duty transformer.
- Quality plated fiberglass PC board.

Less Case, meters & jacks

39.95 UPS SHIPPING PAID!

Public Notice!

THE PS-14 HIGH CURRENT POWER SUPPLY KIT HAS BEEN SELLING FOR 39.95 FOR OVER A YEAR. IN EXCESS OF ONE THOUSAND KITS HAVE BEEN SOLD AT THIS PRICE.

WE WOULD LIKE TO GIVE OUR CUSTOMERS A CHANCE TO PURCHASE THE KIT AT THIS PRICE BEFORE A SCHEDULED INCREASE TO 43.00 IN SEPTEMBER.

WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 6–12VDC at up to 1 amp (using 12VDC+8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker. ORDER WB–02

2.50

MINI GRANDFATHER CLOCK KIT

Complete Electronics!

- Chimes the hour (ie: 3 times for 3 O'clock)
- Unique "swinging" LED pendulum
- Tick tock sound matches pendulum swing.
- Large 4 digit .5" LED readout
- All CMOS construction
- Complete electronics including transformer & speaker; drilled and plated PC boards measure 4.5" x 6.5"

39.95

BEAUTIFUL SOLID WALNUT

Custom case for above kit. Over 9½" tall. **19.95**

OVERVOLTAGE PROTECTION KIT

6.95

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

MK-03A CLOCK/TIMER KIT

Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case.

9–14VDC

28.95

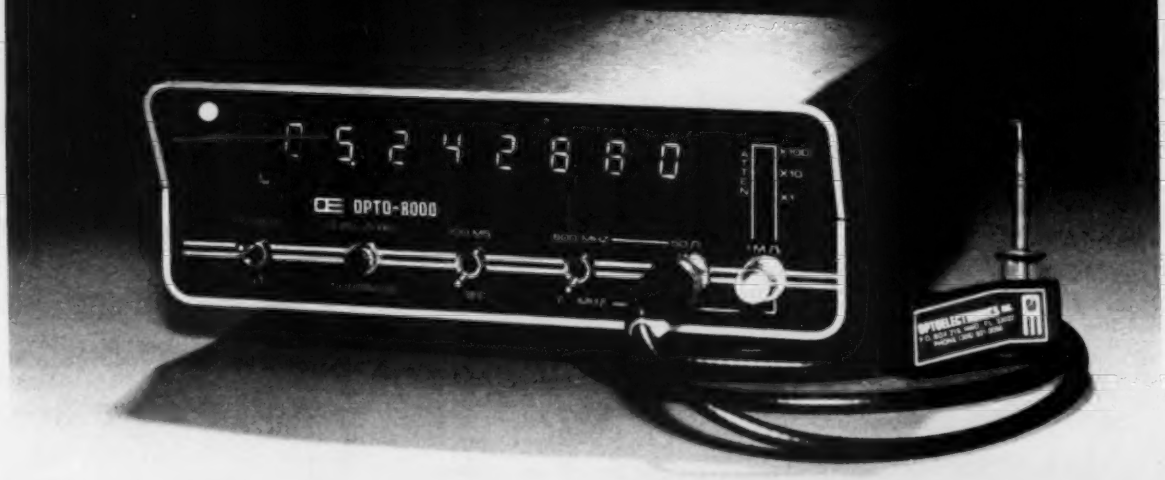
★ NO C.O.D.'S
★ SEND CHECK M.O. OR CHARGE CARD NO.
★ PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY.

★ ADD 5% FOR SHIPPING
★ TX. RES. ADD 5% STATE SALES TAX
★ ORDERS OF $50. & OVER TAKE 10% DISCOUNT
★ FOREIGN ORDERS ADD 10% (20% AIRMAIL) U.S. FUNDS ONLY.

600 MHZ. FREQUENCY COUNTER

±0.1 PPM TCXO

OPTO-8000.1



This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090" thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3"h x 7½"w x 6½"d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090" thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired	**$299.95**
OPTO-8000.1K Kit	**$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**

Probes:
P-100—DC Probe, may also be used with scope **$13.95**
P-101—LO-Pass Probe, very useful at audio frequencies **$16.95**
P-102—High Impedence Probe, ideal general purpose usage **$16.95**

VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
Right Angle BNC adapter #RA-BNC **$ 2.95**

FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

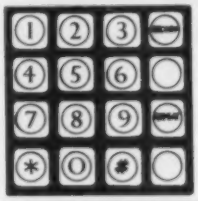
FC-50 — Opto-8000	**Kit $59.95**
*FC-50 — Opto-8000F	**Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO)	**Kit $109.95**
*FC-50 — Opto-8000.1F	**Factory Update $149.95**

*Units returned for factory update must be completely assembled and operational

OPTOELECTRONICS, INC.
5821 NE 14 Avenue
Ft. Lauderdale, FL 33334
Phones: (305) 771-2050 771-2051
Phone orders accepted 6 days, until 7 p.m.

03

TERMS: Orders to U.S. and Canada, add 5% to maximum of $10.00 per order for shipping, handling and insurance. To all other countries, add 10% of total order. Florida residents add 4% state tax. C.O.D. fee: $1.00. Personal checks must clear before merchandise is shipped.



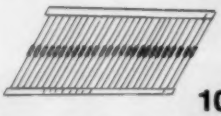
CHOMERICS 16 KEY — KEY PAD

Brand New. Originally used in a data entry-medical Electronics system. Very limited stock. As shown at left, two keys are blank. Perfect for computer experiments or HAM's.

$3.95 EACH **3 FOR $10** LIMITED QTY.

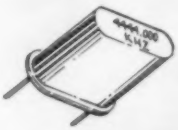
FILTER CAP

2200 MFD 16WVDC
BY PANASONIC. SMALL SIZE.
FRESH! 3 FOR $1.25



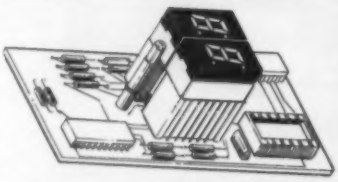
1N4148 DIODE SALE!

FULL LEADS! BRAND NEW!
COMPUTER MFG. SURPLUS
100 FOR $2 1000 FOR $17.50



MORE CRYSTALS!

EXPERIMENTER CRYSTAL #2 — 4.444000 MHZ — **$1.25**
EXPERIMENTER CRYSTAL #3 — 64.000 KHZ — **$1.49**
NOTE: #3 can easily be divided by 64 to give 1000 HZ.



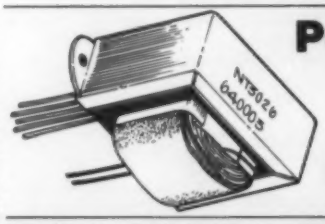
LED READOUT BOARD

Mfg. by Xerox. Has two OPCOA SLA-1 common anode, .33 Inch Readouts. Also has 2 - 7447 drivers and 2-14 pin W.W. sockets plus 2 small lamps. Used in word processors.

$1.59 EACH

MYLAR CAPS

DIPPED, RADIAL LEADS
.1MFD 250 WVDC
10% TOLERANCE
NEW! .10 FOR $1



POWER SUPPLY TRANSFORMER #2

PRIMARY: 115 VAC 60HZ
SECONDARY #1: 24 VAC AT 1.5 AMPS
SECONDARY #2: 20 VAC C.T. AT 1.5 AMPS

BRAND NEW!!! **$3.95** EACH **PART # 640003**

RCA MICRO-POWER OP AMP.

#CA3078T. Metal Can. Most OPAMPS require ±15V to operate. But the CA3078 is designed to operate from ±.75 V to ±6V!!! Perfect for battery use. Standby power as low as 700 NW.! High Gain: 92 DB typical Open Loop Gain. Requires only one capacitor for compensation. See RCA Linear Data Book for more details. Similar to National LM112. Originally cost about $2 each.

75¢ EACH 3 FOR $2

KEMET TANTALUM CAPS

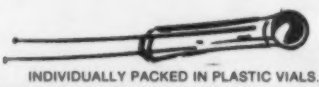
6.8 MFD 15 WVDC
10% TOL. METAL CASE
6 FOR $1 30 FOR $4.25

VECO PRECISION THERMISTORS

GLASS BULB TYPE. SUPER SMALL. VECO #41A72. 8.2K OHMS AT ROOM TEMP. VERY SENSITIVE.

$3 VALUE!

75¢ EACH 3 FOR $2



INDIVIDUALLY PACKED IN PLASTIC VIALS.

ROTRON FANS

#CT3A52 - CENTAUR. 4¾" SQUARE.
220 VAC 60 HZ. WILL WORK ON 117 VAC.
REMOVED FROM NEW EQMT.

LIMITED STOCK **$5.95** EACH

REQUESTED ITEMS:

SIGNETICS 8T26 - QUAD BI-DIRECTIONAL BUSS DRIVER. TRI-STATE. **$1.25** EACH

FAIRCHILD 3348 MOS - HEX 32 BIT SHIFT REGISTER 24 PIN DIP **$1.95** EACH

IC SPECIALS

74L73 - DUAL JK FF - LOW POWER - **10/$1**
945 - ITT HOUSE #. DTL FLIP FLOP - **20/$1**
BOTH ARE 14 PIN DIPS. NEW. PRIME!

2N706 TRANSISTOR

NPN. TO-18. A WORK HORSE RF UNIT. **8/$1**

D20 **Digital Research Corporation**
(OF TEXAS)
P. O. BOX 401247 • GARLAND, TEXAS 75040 • (214) 271-2461

TERMS: Add 30¢ postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa, Mastercharge, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items.

New!

16K E-PROM CARD

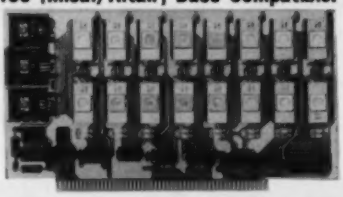
IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
2. Selectable wait states.
3. All address lines & data lines buffered!
4. All sockets included.
5. On card regulators.

KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add $25. for assembled and tested.



PRICE CUT!

$57.50 kit

WAS $69.95

SPECIAL OFFER:

Our 2708's (450NS) are $12.95 when purchased with above kit.

Fully Static!

ADD $20 FOR 250NS

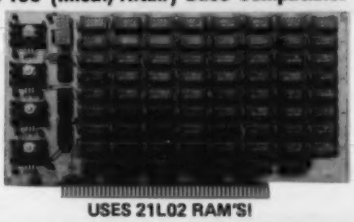
8K LOW POWER RAM KIT-$149.00

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

(450NS)



USES 21L02 RAM'S!

2 KITS FOR $279

Fully Assembled & Burned In $179.00

Blank PC Board w/ Documentation $29.95

Low Profile Socket Set 13.50

Support IC's (TTL & Regulators) $9.75

Bypass CAP's (Disc & Tantalums) $4.50

MOTOROLA QUAD OP - AMP
MC 3401. PIN FOR PIN SUB. FOR POPULAR LM 3900.
3 FOR $1

ALARM CLOCK CHIP
N.S. MM5375AA. Six Digits. With full Data. **New!**
$1.95 each

FULL WAVE BRIDGE
4 AMP. 200 PIV.
69¢ 10 FOR $5.75

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA output. TO–220. 5VDC output.
44c each or 10 for $3.95

450 NS! 2708 EPROMS
Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.
$15.75 ea. 4 FOR $50.00

INTEL 2102 RAM SALE!

BRAND NEW 2102A-4. FACTORY PRIME!

WE MADE ANOTHER SUPER SURPLUS BUY!

PERFECT FOR USE WITH OUR BLANK 8K PC BOARD SHOWN ABOVE.

THESE PARTS HAVE BEEN **SCREENED** TO MEET THE LOW POWER SPEC. AND ARE GUARANTEED BY US TO BE 40 MA. MAXIMUM ICC.
(28 MA. TYPICAL)

LOW POWER

450 N.S.

"A" VERSION FOR BATTERY BACKUP!

8 FOR $7.95
32 FOR $28

4K STATIC RAM'S
2114. The new industry standard. Arranged as 1K x4. Equivalent to 4-21 L02's in 1 package! 18 pin DIP. 2 chips give 1Kx8.
2/$24. 8/$85.

OPCOA LED READOUT
SLA-1. Common Anode. .33 inch character size. The original high efficiency LED display. **75c ea.**
4 FOR $2.50

Z-80 PROGRAMMING MANUAL
By Mostek, The major Z-80 second source. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press. **$12.95**

NATIONAL SEMICONDUCTOR
JUMBO CLOCK MODULE
MA1008A BRAND NEW

$6.95
3 FOR $19

FEATURES:
- FOUR JUMBO ½ INCH LED DISPLAYS
- 12 HR REAL TIME FORMAT
- 24 HR ALARM SIGNAL OUTPUT
- 50 OR 60 Hz OPERATION
- LED BRIGHTNESS CONTROL
- POWER FAILURE INDICATOR
- SLEEP & SNOOZE TIMERS
- DIRECT LED DRIVE (LOW INPUT)
- COMES WITH FULL DATA

(AC XFMR $1.95)

ASSEMBLED! NOT A KIT!

ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock.
#MA1008D — $9.95

PERFECT FOR USE WITH A TIMEBASE.

COMPARE AT UP TO TWICE OUR PRICE!

MANUFACTURER'S CLOSEOUT!

SALE!
1N4148 DIODES. SILICON. Same as 1N914. New, factory prime, Full Leads.
100 FOR $2
1000 FOR $17.50

New! REAL TIME Computer Clock Chip
N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. **$4.95 with Data**

MICRO-MINI TOGGLE SWITCH

99¢ EACH

SPDT. By RAYTHEON. MADE IN USA! WITH HDWR.
6 FOR $5

Digital Research Corporation

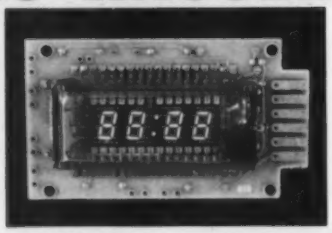
(OF TEXAS)

P. O. BOX 401247 • GARLAND, TEXAS 75040 • (214) 271-2461

TERMS: Add 30¢ postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa, Mastercharge, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items.

satisfaction starts here

THE NO-HASSLE CLOCK



The MA1003 is a complete clock module, requiring only time-setting switches, case, and 12V DC. With built-in crystal controlled timebase (ideal for car or van clock) and low power, highly visible flourescent blue readouts. If you can find a simpler or better way to build a clock . . . tell us about it!
$16.50 each or 3/$46.

REGULATORS SOLD HERE SPECIAL $1.00

Last two digits indicate voltage; **78** series regulators are positive and cost ~~$1.25~~ each, **79** series regulators are negative and cost ~~$1.55~~ each. Voltages available: **7805, 7806, 7808, 7812, 7815, 7824; 7905, 7906, 7908, 7912, 7915, 7918, 7924.**

COMPETITIVE PRICES ON QUALITY SOCKETS

Sockets simplify maintenance and servicing, eliminate heat damage while soldering, and minimize CMOS static problems . . . we've got the right sockets at the right prices.

Low Profile Soldertail (tin plated)

SKL8	8 pin	10/$1.85
SKL14	14 pin	10/ 1.95
SKL16	16 pin	10/ 2.15
SKL18	18 pin	8/ 2.25
SKL20	20 pin	8/ 2.75
SKL22	22 pin	8/ 2.95
SKL24	24 pin	3/ 1.10
SKL36	36 pin	5/ 2.75
SKL40	40 pin	2/ 1.25

YES, WE HAVE COMPONENTS.

That means passive components, semiconductors (FETs, transistors, etc.), ICs (TTL, CMOS, low power Schottky,, and linears — including the 78 and 79 series of voltage regulators), kits, power supplies, Vector products, readouts . . . but we could go on all day. Just send for our flyer, and you'll get all the details.

We want to be your memory supplier: and that means offering a superior product at the lowest possible price.

MEET THE ECONORAM FAMILY . . .

These **static** memory kits deliver outstanding performance at prices even the dynamics can't match. What others consider "extras" we consider necessities, such as buffering on all lines, reliable DMA, sockets, gold-plated card fingers . . . and all the other signs of quality that make up an Econoram.

More good news: Our memory kits (except Econoram II) are now "Unkits". **All** sockets and bypass caps are pre-soldered into place, turning an otherwise tedious assembly job into a pleasurable, one evening project.

24K ECONORAM VII™

A dense and flexible S-100 board that draws less than 2500 mA. Configured as two 8K and two 4K blocks with independent addressing and protection. Use with or without phantom lines. Add $40 for assembled/tested.

$445

16K ECONORAM IV™

Ideal for S-100 buss system builders who need a big chunk of memory that draws less than 2000 mA. Manual write protect for 4K blocks; use with or without phantom line. Add $35 for assembled/tested.

$279

8K ECONORAM II™

Just try to find a more cost-effective S-100 package! Better yet, get 3 kits (24K of memory) for only $375. Add $20 per board for assembled/tested.

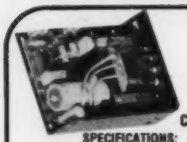
$135

GODBOUT G4

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

TERMS: Please allow up to 5% for shipping; excess refunded. Add $1 handling for orders under $10. Cal res add tax. COD OK with street address for UPS. For VISA® /Mastercharge® orders ($15 min) call our 24 hr. order desk at **(415) 562-0636**. Prices good through cover month of magazine.

ELPAC POWER SUPPLIES



Completely Assembled

SPECIFICATIONS:
105-125/210-250 Vac, 47-440 Hz input:
Line Regulation ±0.1%
Load Regulation ±0.1%no-load to rated-load
Output Ripple and Noise ±0.1%p-p,dc to 10 MHz
Input/Output Isolation 100 megohm dc, 900 Vac
Short Circuit Current 35% rated current

PART NO.	RATINGS WATTS	VOLTS	AMPS	PRICE
SOLV15-5*	15	5	3	$36.95
SOLV15-12*	15	12	1.5	36.95
SOLV30-5	30	5	6	59.95
SOLV30-12	30	12	3	59.95
OVP1	over voltage protection for SOLV30-5,-12			9.95

*SOLV15-5, 12 includes OVP installed

NEW! BULB-ENERGY SAVER

Bulb lasts 3 or more times longer. Fits Standard Socket. 8 watts to 250 watts

BULB-ENERGY SAVERS used for years by major industrial users — now available for home or office use. Bulb Savers can cut electrical bills by as much as 3%.
BULB-SAVERS lengthens light life by:
1. Acting as an electrical "shock absorber", turns the bulb on slowly, eliminating the "thermal shock". Bulb life increases 300 percent.
2. Remains Correct "Surges". Cushions line voltage surges when other loads cut power line.
3. Reduces Energy Consumption

	1-9	10+
BES-1	1.39 ea.	1.20

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5.95
CY1.84	1.8432MHz	HC33	5.95
CY2A	2.000MHz	HC33	5.95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4.95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4.95
CY4.91	4.915MHz	HC18	4.95
CY7A	5.000MHz	HC18	4.95
CY5.18	5.185MHz	HC18	4.95
CY6.14	6.144MHz	HC18	4.95
CY6.40	6.400MHz	HC18	4.95
CY6.55	6.5536MHz	HC18	4.95
CY12A	10.000MHz	HC18	4.95
CY14A	14.31818MHz	HC18	4.95
CY19A	18.000MHz	HC18	4.95
CY18.43	18.432MHz	HC18	4.95
CY22A	20.000MHz	HC18	4.95
CY30A	32.000MHz	HC18	4.95

TRIMMERS

10MM size trimmers -.394" Dia.

Part No.	1-9	10-24	25-49	100+
TR-11(valve)	.35	.30	.25	.20

Resistance values - 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1 meg

TRIMPOTS

Single-Turn - 1/2 Watt
Square - Top Adjust - 3/8" Size

Part No.	1-9	10-24	25-49	50-99
840P(value)	.99	.89	.80	.70

Resistance Values - 50, 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1 meg

15-Turn - 3/4 Watt
Rectangular Side Adjust 3/4" x 1/4" Size

Part No.	1-9	10-24	25-49	50-99
830P(value)	1.35	1.25	1.20	1.15

Resistance Values - 50, 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1 meg

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No.	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	04P44 062XXXP	4.50	6.50	1.72	1.54
	100P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	04P44 062WE	4.50	6.50	2.57	1.88
	04P44 062WC	4.50	8.50	2.56	2.21
	100P44 062WE	4.50	17.00	5.04	4.53
	100P94 062WC	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	100P44 062WEC1	4.50	17.00	6.80	6.12

CONNECTORS

25 Pin-D Subminiature

DB25P(as pictured)	PLUG	$3.25
DB25S	SOCKET	4.95
DB51226-1	Cover for DB25 P or S	1.75

MOLEX CONNECTOR PINS

M-530-1 — $1.95/100 pins (minimum order) $16.00/1000 pins

Pre-packaged in strips

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16".

$3.49

MICROPROCESSOR COMPONENTS

P8085	CPU	$29.95	CDP 1802	CPU	$19.95
8080A	CPU	10.95	Z80	CPU	24.95
8212	8-Bit Input/Output	4.95	Z80	MPU	29.50
8214	Priority Interrupt Control	7.95	MC6800	MPU	19.95
8216	Bi-Directional Bus Driver	4.95	MC6810AP1	128 x 8 Static Ram	5.95
8224	Clock Generator/Driver	5.95	MC6820	Periph. Interface Adapter	7.95
8228	System Controller/Bus Driver	5.95	MC6821	Periph. Interface Adapter	11.50
8251	Prog. Comm. Interface	9.95	MC6830L8	1024 x 8 Bit ROM	14.95
8255	Prog. Periph. Interface	10.95	MC6850	Asychronous Comm. Adapter	14.95

RAM'S

1101	256 x 1 Static	$ 1.49	
1103	1024 x 1 Dynamic	.99	
2101	256 x 4 Static	5.95	
2102	1024 x 1 Static	1.75	
2107-B/B9	4096 x 1 Dynamic	4.95	
2111	256 x 4 Static	6.95	
2112	256 x 4 Static	5.95	
2114	4K x 1 Static 450ns	9.95	
2114L	4K x 1 Static 450ns Low Power	10.95	
2114-3	1K x 4 Static 300ns	10.95	
2114L-3	1K x 4 Static 300ns Low Power	11.95	
7489	16 x 4 Static	1.75	
8101	256 x 4 Static	5.95	
8111	256 x 4 Static	6.95	
8589	16 x 4 Static	3.49	
21L02	1024 x 1 Static	1.95	
74200	256 x 1 Static	6.95	
93421	256 x 1 Static	2.95	
MM5262	2K x 1 Dynamic	$11.95	
MK4027 (UPD414)	4K DYNAMIC 16 PIN	5.95	
MK4116 (UPD416)	16K DYNAMIC 16 PIN	29.95	
TMS4044-80NL	4K STATIC	14.95	

ROM'S

2513(2140)	Character Generator (upper case)	$ 9.95
2513(3601)	Character Generator (lower case)	9.95
2516	Character Generator	10.95
MM52320N	2048 Bit Read Only Memory	1.95

USER MANUALS

1802M	CDP1802 Manual	$ 7.50
Z80M	Z80 Manual	7.50
2650M	2650 Manual	5.00

PROMS

1702A	2048 x 1	Fameos $ 5.95
2708	1024 x 1	Fameos 14.95
82S23	32 x 8	Open C 5.00
82S115	4096 x 1	Bipolar 19.95
82S123	32 x 8	Tristate 5.00
74S287	1024 x 1	Static 7.95
2708	8K	EPROM 19.95
2716 T.I.	16K	EPROM 39.95
2716 Intel (2516 T.I.)	16K	EPROM 59.95
6301-1	1024 x 1	Tri-State Bipolar 3.49
6330-1	256 x 1	Open C Bipolar 2.95
74186	512 x 1	TTL Open Collector 9.95
74188	256 x 1	TTL Open Collector 3.95

SHIFT REGISTERS

MM6013N	1024 Bit Accumulator Dynamic	2.95
MM5010H	500/512 Bit Dynamic	.99
MM5017N	Dual 500/512 Bit Dynamic	2.95
2504T	1024 Dynamic	2.95
2516	Hex 32 Bit Static	4.95
2519	Hex 40 Bit Static	4.99
3522	Dual 132 Bit Static	2.95
2524	512 Dynamic	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.99
2529	Dual 240 Bit Static	4.99
2532	Quad 80 Bit Static	2.95
2533	1024 Static	2.95
3341	Fifo	6.95
74LS670	4 X 4 Register	1.95

UART'S

AY-5-1013	30K BAUD	$ 5.95

SPECIAL REQUESTED ITEMS

TELEPHONE

KEYBOARD CHIPS

AY-5-9100	$14.95
AY-5-9200	14.95
AY-5-9300	4.95
AY-5-2376	14.95
HD0165	7.95
74C922	9.95

TCM CHIPS

ICM7045	$24.95
ICM7205	19.95
ICM7207	7.50
ICM7208	19.95
ICM7208	6.95

TV GAME CHIP SET
AY-3-8500-1 Chip and 2.010 MHz Crystal **$7.95**

MEMORIES

MCM6571	$13.00
MCM6574	13.50
MCM6575	13.50

HAND HELD ONLY

MISCELLANEOUS

11C90	$10.95	MK40240	$17.50
MC6061P	11.95	DS8668CH	3.75
MC1408L7	4.95	TIL308	10.20
MC1408L8	5.75	80H00	11.95
LD110/111	$25.00/set		
MC6010(74410)	7.50		
4633	3.95		

The Sinclair PDM35. A personal digital multimeter for only $59.95

Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment.
The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet they're neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

The Sinclair PDM35 is supplied completely assembled with test leads and probe, protective wallet and Operator's Manual.
The Sinclair PDM35 is tailor-made for anyone who needs to make rapid measurements. Development engineers, field service engineers, lab technicians, computer specialists, radio and electronic hobbyists will find it ideal.

Technical specifications
DC Volts (4 ranges)
Range: 1 mV to 1000 V
Accuracy of reading 1.5% ± 1 count.
Note: 10 MΩ input impedance.
AC Volts (40 Hz–5 kHz)
Range: 1 V to 500 V.
Accuracy of reading: 1.5% ± 2 counts.
DC Current (5 ranges)
Range: 1 mA to 200 mA.
Accuracy of reading: 1.5% ± 1 count.
Note: Max. resolution 0.1 mA.
Resistance (5 ranges)
Range: 1Ω to 20 MΩ.
Accuracy of reading: 1.5% ± 1 count.
Also provides 5 switched-test ranges.
Dimensions: 6 in x 3 in x 1½ in.
Weight: 6½ oz.
Power supply: 9 V battery or Sinclair AC adaptor, (battery not incl.)
Sockets: Standard 4 mm for resilient plugs.
Options: AC adaptor for 117 V 60 Hz power. On-foam padded carrying wallet.

PART NO.	DESCRIPTION	PRICE
PDM35	Digital Multimeter (Completely Assembled)	$59.95
PDM-AC	117volt AC Adaptor	8.95
PDM-DP	Deluxe padded carrying case	6.95

3½ Digit Portable DMM

- Overload Protected
- 3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overrange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage - 0-1000V; AC Voltage: 0-1000V; Freq. Response 50-400 Hz; DC/AC Current: 0-100mA; Resistance 0-10 meg ohm; Size: 6.4" x 4.4" x 2"

Model 2800 $99.95
Comes with test leads, operating manual and spare fuse.

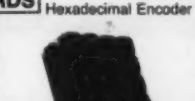
Accessories:

AC Adaptor BC-28	$8.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.30" x 5.65"
- Four power sources, i.e. batteries, 110 or 220V with charger 12V with auto lighter adaptor and external 7.2-10V power supply

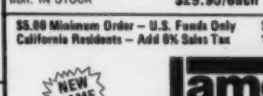
MAX-100 $134.95



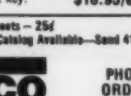
ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator use power from car battery	Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC	Model 100 — CAI $9.95

63-Key Unencoded KEYBOARDS Hexadecimal Encoder



This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK **$29.95/each**



19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **$10.95/each**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1979 A Catalog Available—Send 41¢ stamp

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Jameco ELECTRONICS

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Advertised Prices Good Thru September

PHONE ORDERS WELCOME (415) 592-8097

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "humming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity	—46 dbm accoustically coupled.
Transmit Level	—16 dbm nominal. Adjustable from —6 dbm to —25 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 3" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

The Original the 3rd Hand

$9.95 each

- Leaves two hands free for working
- Clamps on edge of bench, table or work bench
- Position board on angle or flat position for soldering or clipping
- Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One
- Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4¾ ounces)
- Uses 3 Penlite Cells

Kit — $39.95
Assembled — $49.95
Heavy Duty Carry Case $5.95

Stop Watch Chip Only (7205) $19.95

3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model KB503 5V Power Kit $17.50

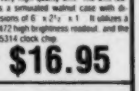
JE700 CLOCK

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6 x 2½ x 1. It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

12 or 24 Hour

115 VAC **KIT ONLY $16.95**

JE803 PROBE



The Logic Probe is a unit which is for the most part indispensable in trouble shooting logic families, TTL, DTL, RTL, CMOS. It denotes the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols: (H) 1 (LOW) 0 (PULSE) P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

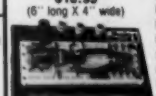
$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply

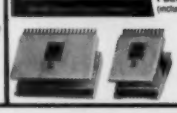
This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package including the hardware for only **JE225 $9.95 Per Kit**

PROTO BOARDS

PROTO BOARD 6
$15.95
(6" long X 4" wide)



PB100	4.5" x 6"	$ 19.95
PB101	5.8" x 4.5"	29.95
PB102	7" x 4.5"	39.95
PB103	9" x 6"	59.95
PB104	9.5" x 8"	79.95
PB203	9.75 x 6½ x 2¾	90.00
PB203A	9.75 x 6½ x 2¾ (includes power supply)	129.95



PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zener	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25

SOCKETS/BRIDGES

8-pin	pcb	.20	ww	.35
14-pin	pcb	.20	ww	.40
16-pin	pcb	.20	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.35	ww	.95
24-pin	pcb	.35	ww	.95
28-pin	pcb	.45	ww	1.25
40-pin	pcb	.50	ww	1.25
Molex pins .01		To-3 Sockets		.25
2 Amp Bridge		100-prv		.95
25 Amp Bridge		200-prv		1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN (2N2222 Plastic .10)	.15
2N2907	PNP	.15
2N3906	PNP (Plastic - Unmarked)	.10
2N3904	NPN (Plastic - Unmarked)	.10
2N3054	NPN	.35
2N3055	NPN 15A 60v	.50
T1P125	PNP Darlington	.35
LED Green, Red, Clear, Yellow		.15
D.L.747	7 seg 5/8" High com-anode	1.95
MAN72	7 seg com-anode (Red)	1.25
MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74A	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

C MOS

4000	.15
4001	.15
4002	.20
4004	3.95
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4007	.20
4008	.75
4009	.35
4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
4021	.75
4022	.75
4023	.20
4024	.75
4025	.20
4026	1.95
4027	.35
4028	.75
4030	.35
4033	1.50
4034	2.45
4035	.75
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
MC 14419	4.85
4511	.95
74C151	1.90

— T T L —

7400	.10	7473	.25	74176	.85	74H72	.35	74S133	.40
7401	.15	7474	.30	74180	.55	74H101	.75	74S140	.55
7402	.15	7475	.35	74181	2.25	74H103	.55	74S151	.30
7403	.15	7476	.40	74182	.75	74H106	.95	74S153	.35
7404	.10	7480	.55	74190	1.25			74S157	.75
7405	.25	7481	.75	74191	.95	74L00	.25	74S158	.30
7406	.25	7483	.75	74192	.75	74L02	.20	74S194	1.05
7407	.55	7485	.55	74193	.85	74L03	.25	74S257 (8123)	1.05
7408	.15	7486	.25	74194	.95	74L04	.30		
7409	.15	7489	1.05	74195	.95	74L10	.20	74LS00	.20
7410	.15	7490	.45	74196	.95	74L20	.35	74LS01	.20
7411	.25	7491	.70	74197	.95	74L30	.45	74LS02	.20
7412	.25	7492	.45	74198	1.45	74L47	1.95	74LS04	.20
7413	.25	7493	.35	74221	1.00	74L51	.45	74LS05	.25
7414	.75	7494	.75	74367	.75	74L55	.65	74LS08	.25
7416	.25	7495	.60			74L72	.45	74LS09	.25
7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.25
7420	.15	74100	1.15	75491	.50	74L74	.45	74LS11	.25
7426	.25	74107	.25	75492	.50	74L75	.55	74LS20	.20
7427	.25	74121	.35			74L93	.55	74LS21	.25
7430	.15	74122	.55			74L123	.85	74LS22	.25
7432	.20	74123	.35	74H00	.15			74LS32	.25
7437	.20	74125	.45	74H01	.20	74S00	.35	74LS37	.25
7438	.20	74126	.35	74H04	.20	74S02	.35	74LS38	.35
7440	.20	74132	.75	74H05	.20	74S03	.25	74LS40	.30
7441	1.15	74141	.90	74H08	.35	74S04	.25	74LS42	.65
7442	.45	74150	.85	74H10	.35	74S05	.35	74LS51	.35
7443	.45	74151	.65	74H11	.25	74S08	.35	74LS74	.35
7444	.45	74153	.75	74H15	.45	74S10	.35	74LS86	.35
7445	.65	74154	.95	74H20	.25	74S11	.35	74LS90	.55
7446	.70	74156	.70	74H21	.25	74S20	.25	74LS93	.55
7447	.70	74157	.65	74H22	.40	74S40	.20	74LS107	.40
7448	.50	74161	.55	74H30	.20	74S50	.20	74LS123	1.00
7450	.25	74163	.85	74H40	.25	74S51	.25	74LS151	.75
7451	.25	74164	.60	74H50	.25	74S64	.15	74LS153	.75
7453	.20	74165	1.10	74H51	.25	74S74	.35	74LS157	.75
7454	.25	74166	1.25	74H52	.15	74S112	.60	74LS164	1.00
7460	.40	74175	.80	74H53J	.25	74S114	.65	74LS193	.95
7470	.45			74H55	.20			74LS367	.75
7472	.40							74LS368	.65

9000 SERIES

9301	.85	95H03	1.10
9309	.35	9601	.20
9322	.65	9602	.45

LINEARS, REGULATORS, etc.

MCT2	.95	LM320T5	1.65	LM340K15	1.25	LM723	.40
8038	3.95	LM320T12	1.65	LM340K18	1.25	LM725N	2.50
LM201	.75	LM320T15	1.65	LM340K24	1.25	LM739	1.50
LM301	.45	LM324N	1.25	78L05	.75	LM741 (8-14)	.25
LM308 (Mini)	.95	LM339	.75	78L12	.75	LM747	1.10
LM309H	.65	7805 (340T5)	.95	78L15	.75	LM1307	1.25
LM309K (340K-5)	.85	LM340T12	.95	78M05	.75	LM1458	.65
LM310	.85	LM340T15	.95	LM373	2.95	LM3900	.50
LM311D (Mini)	.75	LM340T18	.95	LM380 (8-14 PIN)	.95	LM75451	.65
LM318 (Mini)	1.75	LM340T24	.95	LM709 (8, 14 PIN)	.25	NE555	.35
LM320K5(7905)	1.65	LM340K12	1.25	LM711	.45	NE556	.85
LM320K12	1.65					NE565	.95
						NE566	1.25
						NE567	.95

MICRO'S, RAMS, CPU'S, E-PROMS

74S188	3.00	8214	8.95
1702A	4.50	8224	3.25
MM5314	3.00	8228	6.00
MM5316	3.50	8251	8.50
2102-1	1.45	8255	10.50
2102L-1	1.75	8T13	1.50
2114	9.50	8T23	1.50
TR1602B	3.95	8T24	2.00
TMS 4044-	9.95	8T97	1.00
		2107B-4	4.95
8080	8.95	2708	9.50
8212	2.95	Z80 PIO	8.50

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WE'RE FIGHTING BACK INFLATION WITH THIS EXCLUSIVE 1¢ SALE

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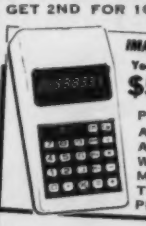
$1.95 2 for $1.96

Factory "lay-arounds." Do they work? Who knows! A micro digital technicians bonanza. The complete guts are there. With black case and leatherette band. 5 functions: HOURS, MINUTES, SECONDS, MONTH, & DATE. Sorry, no specs.
Cat. No. 9A5267 Wt. 4 oz.



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The gamble of a lifetime... YOU CAN'T LOSE! Factory dumps his production-line rejects and customer returns. Why are these rejects? Mostly keyboard problems, we are told. But at these prices, who cares! Vest pocket size: only 3 x 6 x 1" deep.

□ 9A5282 Fluorescent
□ 9A5291 LED

Choose from 2 styles: GREEN fluorescent .5" digits; or RED all-LED .125" digits. Both styles feature 8 digits, 22 keys, 4 arithmetic functions, 4 memory functions, percent, square, clear. All units complete, and include operation manual (Batteries not included). Wt. 6 ozs.

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Quan.	Description (Order by Cat. No. in parenthesis)	Sale	1¢SALE
□	1-40 CHANNEL CB SELECTOR, u/knob, for PLL circuits (#9A5042)	1.00	2 for 1.01
□	1-23 CHANNEL CB SELECTOR, u/knob, for PLL & xtal (#9A5044)	1.00	20 for 1.01
□	1-5 "POP" OPTICAL LENSES, piano-convex, 1" dia, plastic (#9A5045)	1.19	2 for 1.20
□	1-10-IC "DICE", microcomputer circuits, teaches theory (#9A5046)	1.19	2 for 1.20
□	1-6" HI-FI SPEAKER, full range, for car-a-home (#9A5204)	4.95	2 for 4.96
□	1-LED WATCH GUTS, men's, how good? We don't know (#9A5267)	1.95	2 for 1.96
□	1-UHF TUNER, solid state, standard type (#9A2937)	1.00	2 for 1.01
□	10-SLIDE SWITCHES, asst pcb styles (#9A1495)	1.00	20 for 1.01
□	4-TANTALUM CAPACITORS, 0.5 uF 35V, dipped (#9A5281)	1.00	8 for 1.01
□	5-PANCAKE PHOTOCELLS, 900 to 1200 ohms (#9A2939)	1.00	10 for 1.01
□	1-100MHZ MARKER CRYSTALS, square for marker gen (#9A2895)	1.00	2 for 1.01
□	1-MOTHERBOARD EDGE CONNECTOR, 100 pins, .125" (#9A3967)	3.50	2 for 3.51
□	1-40-PIN EDGE CONNECTOR, .156" spacing (#9A3963)	1.95	2 for 1.96
□	1-METER, 50uA, 1½" square, 0-20db (#9A3700)	1.19	2 for 1.20
□	1-SPST RELAY, norm. open 12-24 VDC, 1250 ohms, dip style (#9A5175)	1.00	2 for 1.01
□	1-VERNIER ROOT COUNTER, 000-900, resettable, panel mt. (#9A5081)	1.49	2 for 1.50
□	3-DUAL GATE MOSFET, min. to 3N200, 3N187, for RF & Mixer (#9A5101)	1.00	4 for 1.01
□	3-LED THERMAL INDICATORS, 58-100°F, 7x1", flexible (#9A5105)	1.00	4 for 1.01
□	1-JOYSTICK, four 100K pots, with knob (#9A3008)	4.95	2 for 4.96
□	1-EXCO THUMBWHEEL SWITCH, BCD, 0-7 (#9A3970)	1.49	2 for 1.50
□	1-PLESSEY TV SIDEBAND FILTER, for chan. 3 or 4 (#9A3975)	1.95	2 for 1.96
□	1-28V NI-CAD CHARGER PAK, plug-in, 125ma, 115 VAC prf (#9A4000)	4.95	2 for 4.96
□	36-DATA ENTRY PUSH-SWITCHES, spst, norm open, for keyboards (#9A5278)	2.00	40 for 2.01
□	75-SN7400 TTL ICs, untested 50%+ yield, pop types (#9A2415)	2.00	150 for 2.01
□	100-MINI DIP ICs, linears, untested 50%+ yield, pop types (#9A2348)	2.00	150 for 2.01
□	30-LM380 AUDIO IC's, 2 watts on-a-dip 50%+ yield (#9A3286)	2.00	60 for 2.01
□	75-LINEARS, OP AMPS, untested 50%+ yield, some dips-minidips (#9A3416)	2.00	150 for 2.01
□	100-TTLs & LINEAR MIXED, with 7400s, 50%+ yield (#9A2431)	2.00	300 for 2.01
□	1- JOYSTICK, two 10K pots, for computers, TV games (#9A5037)	2.95	2 for 2.96
□	1-8-TRACK TAPE HEADS, with plug' n' cord (#9A3494)	3.50	2 for 3.51
□	150-PREFORMED DISC CAPACITORS, mark-d values, asst'd (#9A3005)	2.00	300 for 2.01
□	150-TRIMMER CAPACITORS, mica compression, piston, asst'd. (#9A3714)	2.00	120 for 2.01
□	60-YELLOW JACKET MYLAR CAPACITORS, untested (#9A3478)	2.00	120 for 2.01
□	100-GLASS ZENERS, 400 MW, untested, better than 50% yield (#9A2740)	3.00	300 for 2.01
□	75-CARBOFILM RESISTORS, ¼, ½ watt, 5 & 10%, marked, asst'd (#9A3534)	2.00	150 for 2.01
□	250-UNMARKED CAPACITORS, polystyrene, molded, pop values (#9A3005)	2.00	500 for 2.01
□	300-SILICON SIGNAL DIODES, micro glass, sensors test 50% yield (#9A3536)	2.00	600 for 2.01
□	8-IC SOCKETS, 14, 16 pin, solder tail. (#9A3621)	2.00	16 for 2.01
□	100-1N4148/914 SWITCHING DIODES, 50%+ yield. Untested (#9A3418)	2.00	200 for 2.01
□	30-PC TRIM POTENTIOMETERS, thumbwheel, asst'd values (#9A3340)	2.00	60 for 2.01
□	15-SLIDE VOLUME CONTROLS, asst'd values, duals, singles (#9A3067)	2.00	30 for 2.01
□	75-4" CABLE TIES, plastic, like "Ty-wrap" (#9A5219)	3.00	150 for 2.01
□	10-CRYSTALS, may include CB, Ham & more (#9A3256)	2.00	20 for 2.01
□	100-TERMINAL STRIPS, pots, with 2 lugs ea (#9A3512)	2.00	200 for 2.01
□	30-ME-2MEON LAMPS, all 100% good (#9A3913)	2.00	60 for 2.01
□	40-ft. SHIELDED CABLE, 1 cond, mikes, phones, (#9A3077)	2.00	80 ft. for 2.01
□	3-SOUND TRIGGERS, sound triggers ear w/amp (#9A3629)	3.00	6 for 3.01
□	10-CB CRYSTALS, for phase lock loop, NAME, (#9A3340)	2.00	20 for 2.01
□	100-DISC CAPACITORS, long leads, marked, asst'd (#9A2900)	2.00	200 for 2.01
□	100-CAPACITOR SPECIAL, disco, mylar, lytics, more (#9A2728)	2.00	200 for 2.01
□	10-VOLTAGE REGULATORS, hobby 340, TO-3 (#9A3336)	2.00	20 for 2.01
□	30-PANEL SWITCHES, slides, rotaries, mod, etc (#9A3268)	2.00	60 for 2.01
□	200-RESISTOR SPECIAL, ¼ to 1W, carbon, metal (#9A3054)	2.00	400 for 2.01
□	300-HALF WATTERS, resistors, carbon, metal (#9A3040)	2.00	600 for 2.01
□	100-NATIONAL IC BONANZA, linears, IC's (#9A3004)	2.00	200 for 2.01
□	15-LM340T VOLTAGE REGULATORS, 5 to 24V, TO-220 (#9A3525)	2.00	30 for 2.01
□	100-POLYSTYRENE CAPS, asst'd values, voltage, hi-Q (#9A2729)	2.00	200 for 2.01
□	50-THERMISTORS, resistors that change with temp (#9A4000)	2.00	100 for 2.01
□	30-BRIDGES, 1 amp, 50 PRV, micro (#9A4022)	2.00	60 for 2.01
□	25-LAMP'N'SOCKET SETS, micro, 1.5V, T2 (#9A3007)	2.00	50 for 2.01
□	15-MIXED READOUTS, hobby, untested, .127, .3, .5, etc. (#9A3519)	2.00	30 for 2.01
□	100-QUARTER WATTERS, resistors, metal film (#9A3613)	2.00	200 for 2.01
□	100-PLASTIC TRANSISTORS, untested, TO-92 (#9A3004)	2.00	200 for 2.01
□	200-PREFORMED RESISTORS, ¼, ½, 1W, marked, asst'd (#9A3000)	2.00	400 for 2.01
□	200-PRECISION RESISTORS, ¼, ½, 1W, 1%, 2% marked (#9A3428)	2.00	400 for 2.01
□	60-DIPPED MYLARS, shiny finish, asst'd values (#9A2907)	2.00	120 for 2.01
□	30-VOLUME CONTROLS, audio, linear, asst'd values (#9A3421)	2.00	60 for 2.01
□	30-CLOCK CHIPS, National, hobby & untested, alarm (#9A3069)	2.00	60 for 2.01
□	30 RESI2O2 2N SERIES, hobby, untested (#9A3040)	2.00	60 for 2.01
□	10-PUSH SWITCHES, push-to-break, spst, piano (#9A3208)	2.00	20 for 2.01
□	25-CD-4000 SERIES CMOS, untested, 50% useable yield (#9A3284)	2.00	50 for 2.01
□	1-CHARACTER GENERATOR, 5 x 7 Mostek MK 2062P (#9A3994)	4.95	2 for 4.96
□	1-CONDENSER MIKES, sensitive, 600 ohms 1.5 Volts (#9A3178)	4.95	2 for 4.96

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ONE CENT SALE

□	3¼ DIGIT LED WRISTWATCH DISPLAY (#9A3900)	3 for $1.10	6 for $1.20
□	9-PEARY FLAT NIXIES, orange, .3" dual digit (#9A3014)	3 for 1.10	6 for 1.20
□	9-SPERRY FLAT NIXIES, orange, .3", dual digit (#9A3015)	3 for 1.10	6 for 1.20
□	MAN-3 BUBBLE READOUT, .19" red. com. cath. (#9A3338)	6 for 1.00	12 for 1.01
□	MAN-4 READOUTS, bubble, red, com. anode, .19" (#9A3563)	2 for 1.00	4 for 1.01
□	FND-10 BLOCK READOUT, .322" com cathode (#9A3902)	2 for 1.19	4 for 1.20
□	9-DIGIT READOUT, led, com cathode, red (#9A5190)	5 for 1.95	10 for 1.96
□	FND-503, .5" red, com cathode, 7-seg. (#9A3949)	1.50	2 for 1.51
□	FND-500, .5" red, com anode, 7 seg. (#9A3950)	1.50	2 for 1.51
□	FND-560, .5" red, common anode, (#9A3030)	1.95	2 for 1.96
□	FND-503, .5" red, common cathode, (#9A3327)	1.95	2 for 1.96

RELAYS!

		Each	2 for
□	1-SPST 24V REED RELAY, norm open, dip style, 1250 ohms (#9A5175)	1.40	1.50

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		Each	2 for
□	9 WATTS ON A CHIP, Toshiba TA7205 (#9A5067)	4.95	4.95
□	3 WATTS ON A CHIP, G-E PA 253 (#9A1522)	1.50	1.51

DIP SWITCHES!

		Each	2 for
□	2 SWITCHES ON A DIP (#9A 3662)	$ .77	$ .78
□	3 SWITCHES ON A DIP (#9A 3663)	.88	.89
□	6 SWITCHES ON A DIP (#9A 3671)	1.39	1.40

IC SOCKETS!

□	8-PIN MINI-DIP (#9A2122)	4 for $1.19	□	9 for $1.20
□	14-PIN DIP (#9A1302)	3 for 1.19	□	6 for 1.20
□	16-PIN DIP (#9A1300)	3 for 1.19	□	6 for 1.20
□	18-PIN DIP (#9A3378)	6 for 1.19	□	12 for 1.20
□	24-PIN HSL/DIP (#9A3926)	2 for 1.19	□	4 for 1.20
□	28-PIN HSL/DIP (#9A3887)	2 for 1.19	□	4 for 1.20

FULL WAVE BRIDGE 10 AMP RECTIFIERS!

Order by Cat. No. 9A2447 & voltage

	PRV	Sale	2 for
□	50	$1.25	$1.30
□	100	1.40	1.50
□	200	1.49	1.70
□	400	1.99	2.00
□	600	2.25	2.26
□	800	2.50	2.51
□	1000	2.75	2.76

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□	#9A1708	MICRO TOPHAT RED	
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□	#9A1704	MICRO SINGLE PIN RED	
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□	#9A1948	JUMBO RED	
□	#9A2138	JUMBO TAPER RED	
□	#9A2136	MICRO RED	
□	#9A2137	JUMBO RED CLEAR	
□	#9A2790		

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Order by Cat. 9A3939 and Conductors

Cond.		Sale	1¢ Sale
□ 26	4-ft.	1.39	6-ft. 1.50
□ 34	4-ft.	1.39	6-ft. 1.50
□ 40	4-ft.	1.39	6-ft. 1.50

.10 AMP - POWER TABS!

9A1730 - SCR'S
9A1440 - TRIACS
9A1890 - QUADRACS

PRV	Sale	2 for
□ 50	$ .55	$ .56
□ 100	.60	.70
□ 200	1.10	1.11
□ 400V	1.60	1.61

LYTIC KLINIC

Order No. 9A3369 and value — Electrolytic capacitors

	UF	V	Style	Sale	1¢ SALE
□	10	10	Ax. P.C.	10 for $1.00	20 for $1.01
□	10	15	P.C.	6 for 1.00	12 for 1.01
□	15	25	P.C.	6 for 1.00	12 for 1.01
□	25	25	P.C.	6 for 1.00	12 for 1.01
□	100	25	P.C.	6 for 1.00	12 for 1.01

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2 for $4.96

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	1 Watt	Sale	1¢ SALE
□	7.5V	5 for $1.	10 for $1.01
□	8.2V	5 for 1.	10 for 1.01
□	9.1V	5 for 1.	10 for 1.01
□	10.V	5 for 1.	10 for 1.01
□	11.V	5 for 1.	10 for 1.01
□	12.V	5 for 1.	10 for 1.01
□	15.V	5 for 1.	10 for 1.01

Order by Cat. No. 9A52100

	5 WATTS	Sale	1¢ SALE
□	6. V	3 for 1.	6 for 1.01
□	6.2V	3 for 1.	6 for 1.01
□	15. V	3 for 1.	6 for 1.01
□	18. V	3 for 1.	6 for 1.01
□	24. V	3 for 1.	6 for 1.01
□	30. V	3 for 1.	6 for 1.01

PENNIES FOR YOUR MEMORIES!

Type	Description	Sale	1¢ Sale!	Order by
□ 1103	1K Dynamic RAM	1.29	1.30	Cat. No.
□ 5262	2K Prom	3.95	3.96	9A3439 &
□ 8362	2K x 1 Dynamic RAM	.99	1.00	
□ 1702A	256 x 8 EPROM	4.95	4.96	Type No.
□ MM5280*	4K x 1 Dynamic RAM	3.95	3.96	

*Removed from new tested equipment

POP-AMPS AT "CENT-CIBLE" PRICES

Case code: T=TO-220 Power Tab; V=Mini dip; K=TO-3; H=TO-5; N=DIP.

Type No.	Each	2 for
□ LM300N	$ .79	$ .80
□ LM300H	.99	1.00
□ LM301V	.45	.46
□ LM301H	.45	.46
□ LM301N	.45	.46
□ LM308V	.29	.30
□ LM308H	.49	.70
□ LM309K	1.49	1.50
□ LM309H	1.19	1.20
□ LM311N	1.49	1.50
□ LM318V	.99	1.00
□ LM320T-5	.99	1.00
□ LM320H-12	.99	1.00
□ LM320H-15	.99	1.00
□ LM320T-6	1.49	1.50
□ LM322N	1.19	1.20
□ LM339N	1.79	1.80
□ LM339H	1.79	1.80
□ LM340K-5	1.49	1.50
□ LM340K-6	1.49	1.50
□ LM340K-8	1.49	1.50
□ LM340K-12	1.49	1.50
□ LM340K-15	1.49	1.50
□ LM340K-18	1.49	1.50
□ LM340K-24	1.49	1.50

Type No.	Each	2 for
□ LM340T-5	1.49	1.50
□ LM340T-6	1.49	1.50
□ LM340T-8	1.49	1.50
□ LM340T-12	1.49	1.50
□ LM340T-15	1.49	1.50
□ LM340T-18	1.49	1.50
□ LM340T-24	1.49	1.50
□ LM377N	.99	.30
□ LM377H	2.25	2.26
□ LM380N	1.39	1.40
□ LM380H	1.39	1.40
□ LM381N	1.49	1.50
□ LM382N	1.49	1.50
□ LM531N	1.00	1.01
□ LM532N	.25	.26
□ LM533N	.25	.26
□ NE540H	5.95	5.96
□ LM555V	.75	.76
□ LM556N	1.79	1.80
□ LM556V	.39	.40
□ LM558N	.39	.40
□ LM561N	1.00	1.01
□ LM565N	1.00	1.01
□ LM567N	1.00	1.01
□ LM566	2.49	2.50
□ LM567	2.39	2.40

Type No.	Each	2 for
□ LM703N	.59	.60
□ LM704N	.59	.60
□ LM709N	.19	.20
□ LM709H	.49	.50
□ LM710N	.79	.80
□ LM741V	.29	.30
□ LM741H	.30	.31
□ LM747N	.59	.60
□ LM747H	1.49	1.50
□ LM1310	1.79	1.80
□ LM1312	2.49	2.50
□ LM1458V	.19	.20
□ LM1458N	.79	.80
□ LM1800N	.79	.80
□ LM3028N	.65	.66
□ LM3900N	.65	.66
□ LM3905V	1.25	1.26
□ LM4250	1.20	1.21
□ LM75451	.59	.70
□ LM75453	.59	.70
□ LM75491	.80	.81
□ LM75492	.80	.81
□ LM75494	.80	.81
□ PA263	1.50	1.51
□ 9M8064N	1.29	1.30

1 AMP SCR'S

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□ 60	3 for $1	6 for 1.01
□ 100	3 for $1	6 for 1.01
□ 200	2 for $1	4 for 1.01
□ 300	1 for $1	2 for 1.01

1N4000 Epoxy Rectifiers

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Cat. No.	Type	Volts	Sale	1¢ SALE!	Type No.
□ 9A2377	1N4001	50	10 for $ .75	20 for $ .76	
□ 9A2378	1N4002	100	10 for .85	20 for .86	• 1.5 Amp!
□ 9A2379	1N4003	200	10 for .95	20 for .96	
□ 9A2380	1N4004	400	10 for 1.10	20 for 1.20	• Mini dips, axial
□ 9A2381	1N4005	600	10 for 1.30	20 for 1.40	
□ 9A2382	1N4006	800	10 for 1.39	20 for 1.50	
□ 9A2383	1N4007	1000	10 for 1.39	20 for 1.50	

25 AMP BRIDGE RECTIFIERS

Order No. 9A2273 & voltage

V	Each	1¢	SALE
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□ 200	1.49	2 for	1.50
□ 300	1.69	2 for	1.70
□ 400	1.99	2 for	2.00
□ 600	2.25	2 for	2.26
□ 800	2.50	2 for	2.51

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Order by Cat. No. 9A5008A4 and voltage

1.5 AMP

□ 50V	10 for $.39	20 for $.60	
□ 100V	10 for .59	20 for .70	
□ 200V	10 for .79	20 for .80	
□ 400V	10 for .89	20 for .90	

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□ 50(m)	□ 50K(m)	□ 2M(m)	□ 10K(s)	□ 250K(m)	□ 1 Meg(m)				

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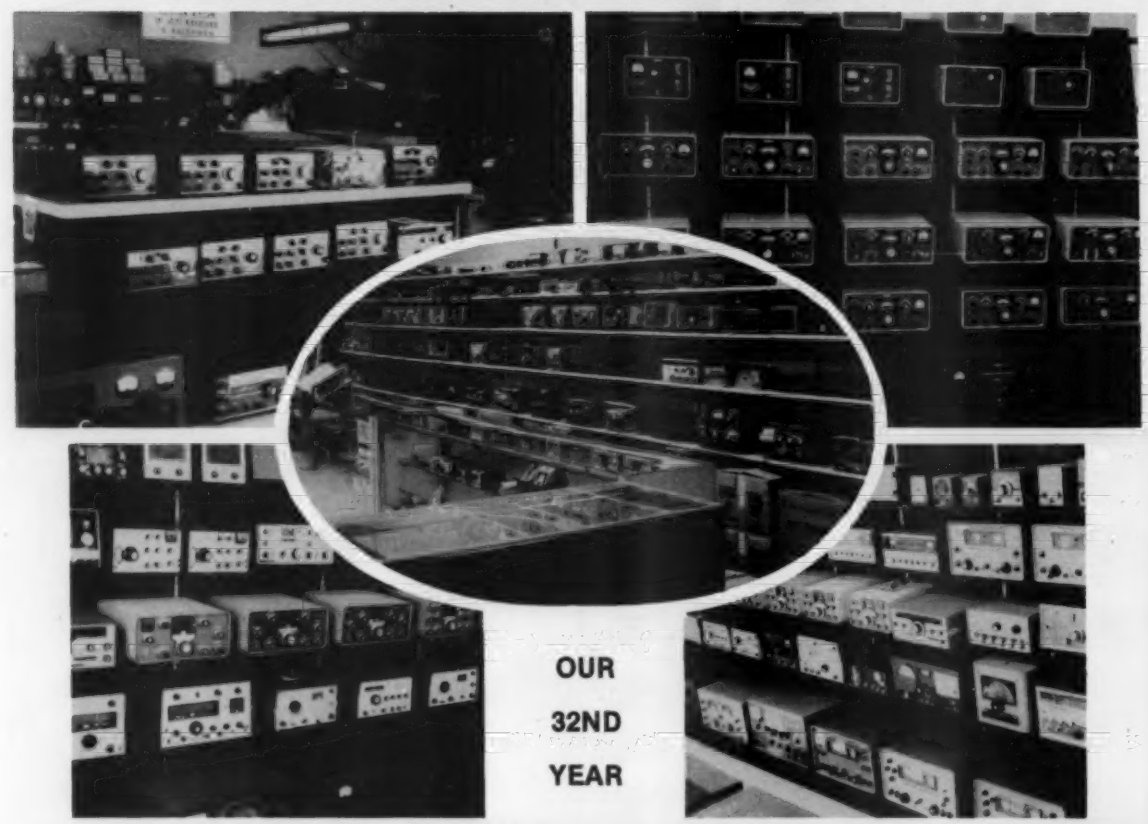

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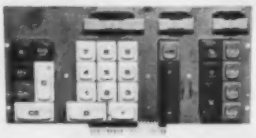

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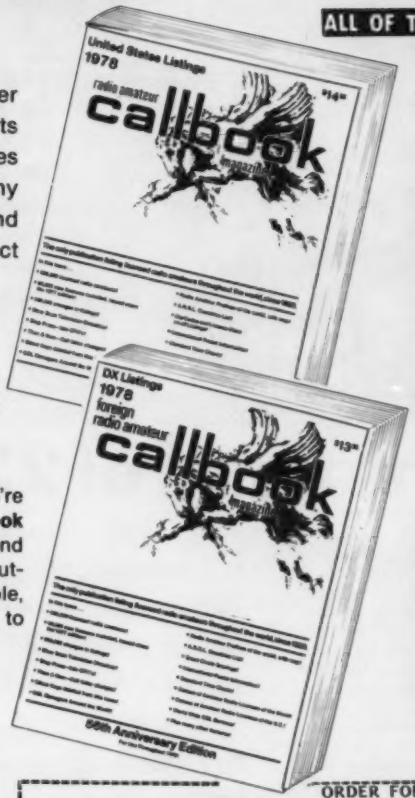

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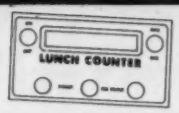

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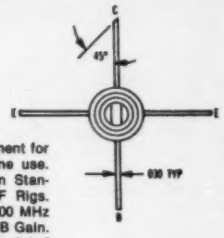

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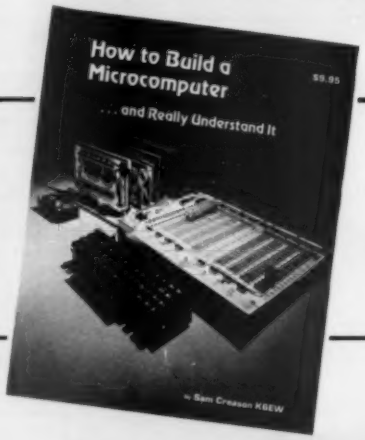

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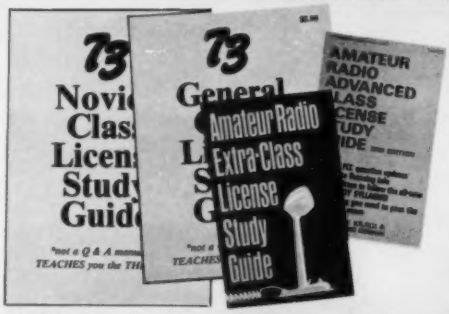

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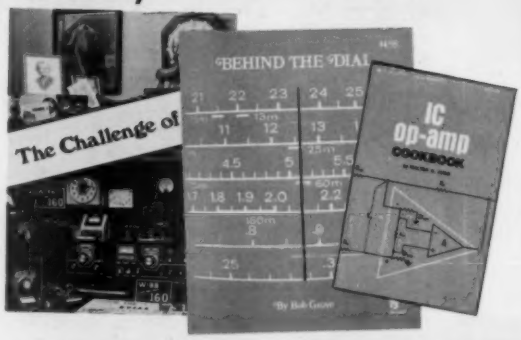

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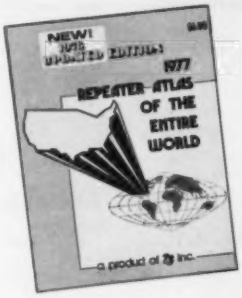

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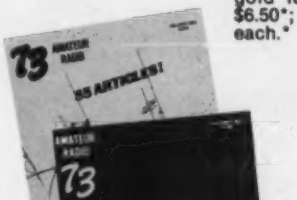

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B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

september

sun	mon	tue	wed	thu	fri	sat
					1 G	2 G
3 G	4 F	5 G	6 G	7 G	8 P/SF	9 P/SF
10 P/SF	11 G/SF	12 G/SF	13 F/SF	14 P/SF	15 P	16 G
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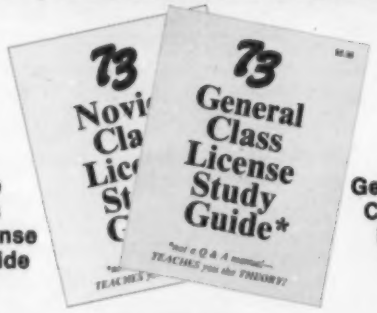

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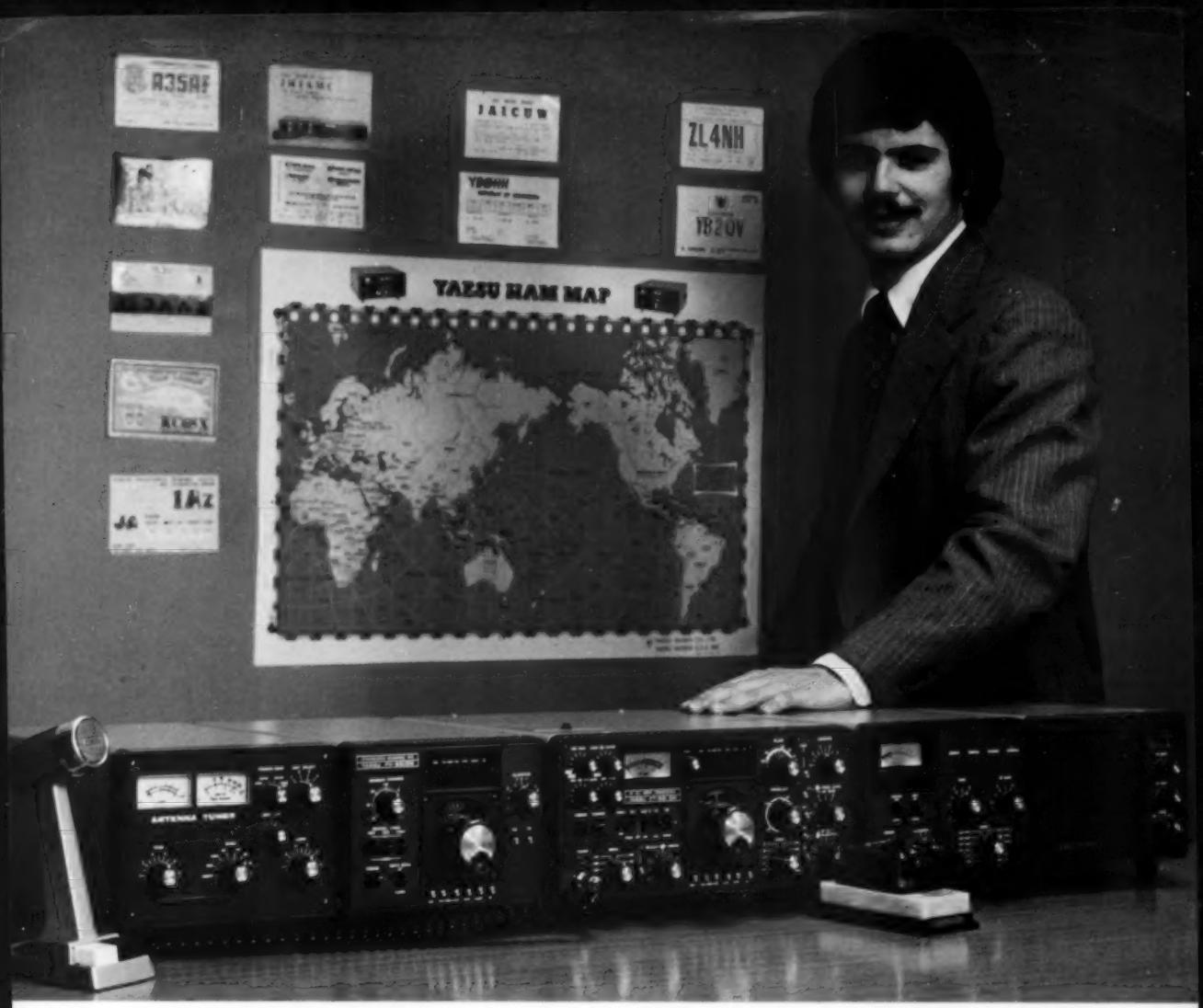

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